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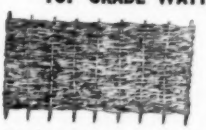

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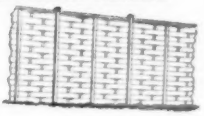

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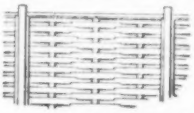

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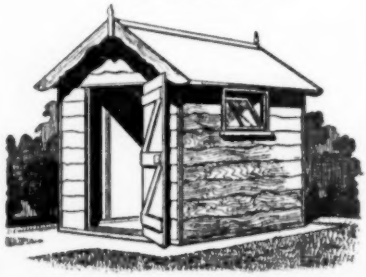

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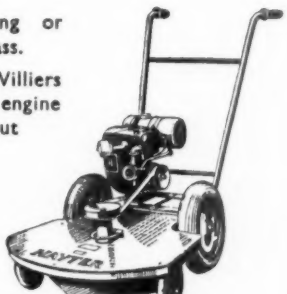

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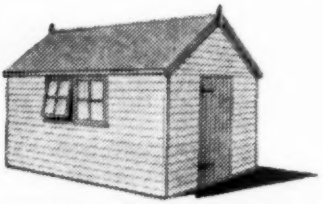

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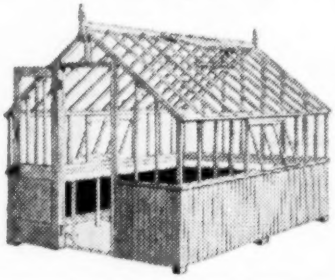

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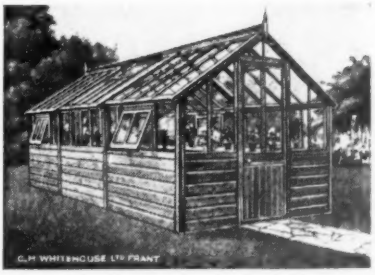

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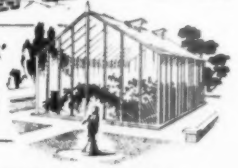

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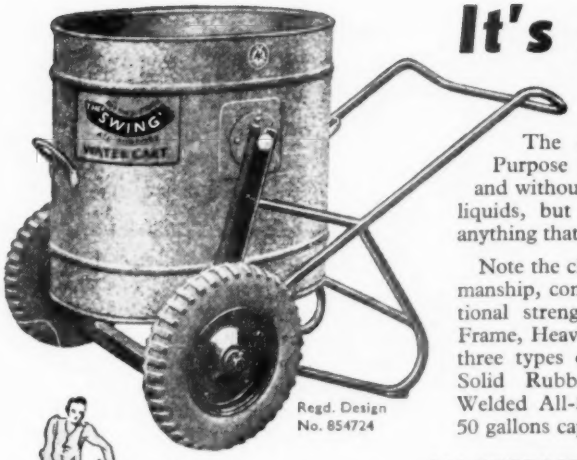

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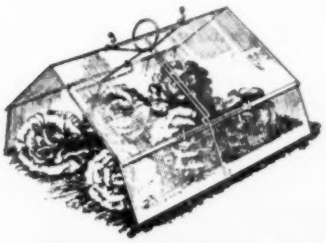

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JOURNAL of The Royal Horticultural Society

VOL. LXXVIII PART 9

SEPTEMBER 1953

THE SECRETARY'S PAGE

ANNOUNCEMENTS—SEPTEMBER AND OCTOBER

Shows

TUESDAY, September 8 12 NOON to 6 P.M. WEDNESDAY, September 9 10 A.M. to 5 P.M.	Fortnightly Show.
TUESDAY, September 15 1 P.M. to 7.30 P.M. WEDNESDAY, September 16 10 A.M. to 5 P.M.	National Dahlia Society's Show.
FRIDAY, September 18 11 A.M. to 7 P.M.	National Rose Society's Show.
TUESDAY, September 22 12 NOON to 6 P.M. WEDNESDAY, September 23 10 A.M. to 5 P.M.	Great Autumn Show. Alpine Garden Society's Competition. Cactus and Succulent Society's Competition.
FRIDAY, September 25 1 P.M. to 7.30 P.M. SATURDAY, September 26 10 A.M. to 6 P.M.	National Chrysanthemum Society's Show.
WEDNESDAY, September 30 2.30 P.M. to 6 P.M. THURSDAY, October 1 12 NOON to 5 P.M.	Royal Air Force Horticultural Show.
TUESDAY, October 6 12.30 P.M. to 6 P.M. WEDNESDAY, October 7, 10 A.M. to 5 P.M.	Fortnightly Show. Fruit and Vegetable Show.

Shows—*continued*

TUESDAY, October 20 12 NOON to 6 P.M. WEDNESDAY, October 21 10 A.M. to 5 P.M.	Fortnightly Show. Tree and Shrub Competition.

The British Beekeepers' Association's National Show will be held in the Old Hall, Vincent Square, as follows: Thursday, October 15, 10 A.M. to 8 P.M.; Friday, October 16, 10 A.M. to 8 P.M.; Saturday, October 17, 10 A.M. to 6 P.M. Admission to the public—*2s. 6d.* Fellows' tickets admit free of charge.

Lectures

There will be no lectures in September.

TUESDAY, October 6, at 3 P.M. "Potato Varieties—Old and New" by MRS. N. MCDERMOTT.

TUESDAY, October 20, at 3 P.M. "The Winkworth Arboretum" by DR. WILFRID S. FOX, V.M.H.

Demonstration at Wisley—There will be a demonstration at Wisley on Wednesday, September 30, of Digging, Trenching, Manuring and Composting in the Vegetable Garden. The demonstration will commence at 2 P.M., and will be repeated at the same time on Thursday, October 1.

Report of the 13th International Horticultural Congress—The Report will be published in September and is in two volumes comprising 1335 pages, fully illustrated. It contains, in addition to a record of the Proceedings at the Opening and Closing Sessions and the Proposed International Code of Nomenclature for Cultivated Plants, ten General Papers dealing with Environment, Soils, Nutrition, Plant Breeding and Growth and Development, together with all the specialized Papers covering Fruit, Vegetables, Ornamental Plants, Plant Breeding, Environmental Control, Seeds and Tropical and Sub-tropical Horticulture. The price of the set of two volumes (which are not sold separately) is £2 4*s.* 9*d.* (U.S. $6.50) post free, and orders should be sent to the Society, together with a covering remittance. The supply is limited and orders should be placed as soon as possible to avoid disappointment.

Great Autumn Show—Attention is drawn to the Great Autumn Show on September 22 and 23. For some years before the War the Society held a Great Autumn Show, latterly at Olympia, and the revival of this Show will be welcomed by Fellows and exhibitors alike. This year it is being held in the Society's Halls, but in 1954 it will again be at Olympia.

The Society's Examinations—The Preliminary Examination for the National Diploma in Horticulture will be held on Saturday, December 5, 1953. The closing date for entry is October 1, 1953.

The Dating of Awards to Plants—The value of nurserymen's and seedsmen's catalogues as guides to the selection of the best kinds and varieties available in the year of publication is greatly enhanced if the catalogues indicate which kinds and varieties have received awards *and the date (year) when each award was made*. In the absence of a date the statement that a plant received an A.M. or an F.C.C. is of little value and may be misleading. Thus if variety "A" received an A.M. after a trial held in 1930, and variety "B" received an A.M. after a trial held in 1950, by which time variety "A" had been superseded, it would be misleading after 1950 to catalogue variety "A" as having received an A.M. unless the year when the award was made were indicated. The Council of The Royal Horticultural Society therefore recommends that whenever a plant is catalogued as having received an award from the Society, whether after trial or otherwise, *the year of the award should always be stated*. It is realized that the cost of printing will militate against the insertion of dates while standing type is in use, but it is hoped that the recommendation will be adopted when new catalogues are printed.

NOTES FROM WISLEY

On entering the Gardens the first view visitors obtain is of the green lawns (usually so free from weeds) beside and in front of the building which to the surprise of most visitors was completed as recently as 1916 and which was designed originally as a laboratory for the conduct of research work on horticulture and on the various allied sciences. Today it houses the administrative and advisory officers and, equipped with laboratories and lecture rooms, it is the headquarters of the School of Horticulture. As no visitor fails to be impressed by the beauty of the building, and as it occupies so prominent a place in the Gardens, it seems not inappropriate to consider a few of the plants which are to be found growing against its walls, and against other walls in the Gardens.

Great use can be made of walls in any garden, for they provide shelter for many a more or less tender plant which would not survive in the open garden. They also provide support for those plants, many of them climbers, which make extensive growth each year and which are not strong enough to support themselves. As plants protected by the wall also help to extend the season of flowering it is possible to have in nearly every month of the year something in flower or in fruit.

There are many fine climbing plants among the Roses and two outstanding examples against the laboratory walls are the admiration of all visitors. Perhaps the one which gives the greatest value is *R.* 'Mermaid,' a hybrid from *R. bracteata*, which first opens its glorious yellow flowers in June and continues throughout the summer and early autumn. Close by is *R. odorata gigantea* 'Belle Portugaise,' a very striking flesh-pink variety and very early flowering. *R. odorata gigantea* 'Sénateur Amic,'

which is to be found on the frameyard wall, is also an early bloomer, usually opening its glowing carmine-red flowers when the nearby Bearded Iris trials are at their best. Other Roses with wall support or protection that we observed this year were *R. anemonoides* 'Ramona' and the Afghanistan *R. Ecae* with rich yellow flowers and fern-like foliage which is happy against the west wall of the Alpine House.

The Pyracanthas, or Fire Thorns, very attractive in flower and frequently quite startling in fruit, are particularly useful for the north wall. There are several species at Wisley growing against the walls as well as in the open borders. *P. coccinea* of Europe and Asia Minor has brilliant coral-red fruits whilst its more vigorous variety *Lalandei* has berries of bright orange-red. The Chinese *P. Rogersiana*, introduced by FORREST, recently received the Award of Merit as a flowering shrub. The berries vary in colour from golden yellow to reddish orange. It should be noted that this plant also makes a very compact and decorative hedge up to 6 feet high. FORREST also sent home a hardier form of *P. angustifolia* than that originally introduced by VILMORIN from seed collected by SOULIE in 1895. *P. angustifolia* with orange-yellow fruits is valuable in that it retains its berries till early spring.

Another plant noted for its wonderful berrying habit and, like the Pyracanthas, belonging to the Rose family, is the Chinese *Cotoneaster horizontalis*. With its herringbone-like branching, its pinkish flowers and marvellous autumn colouring of both berries and leaves, it is a most outstanding plant for the wall. Its flowers are reputed to be especially attractive to queen wasps and in some places it is planted in order that the queen wasps may be ensnared before the nesting season.

Also from China and from FORREST came *Indigofera pendula*. It is wonderfully ornamental, from July until October, holding long racemes of flower, dove grey without, rich rose within. At Wisley it has been cut right back in cold weather but has recovered and flowered well again. Much the same fate is likely to attend the Himalayan dark crimson flowered *I. hebepetala*. Another member of the Leguminosae which at Wisley bloomed particularly well this year was *Caesalpinia japonica*. In contrast to those of *Indigofera*, the racemes of canary-yellow flowers are held upright. The plant should be treated with great respect for it is armed with stout decurved thorns. Rather tender, it is almost certain that it could not survive at Wisley without the protection of the potting shed wall.

Wisteria, so often found growing against a wall, is not very well represented at Wisley. The best plant in the Gardens is *W. floribunda* var. *macrobotrys* which festoons the bridge across the pools at the bottom of the Rock Garden. There are other plants on the Battleston Hill bridges but these are as yet too young to provide much bloom. Still in the Leguminosae we have the European *Coronilla Emerus*, the Scorpion Senna, which produces yellow-tinged red-brown flowers in April and May and again in September and October.

Of the plants originating from the New World, members of the genus *Ceanothus* deserve a place in all gardens even though some may be cut

down in a very hard winter. There are some forty species mostly from California and there are many garden hybrids some of which morphologically are very similar to one another. Roughly they can be divided into two main classes, the small-leaved May flowering species such as *C. Veitchianus* and *C. rigidus*, and the larger-leaved late summer and autumn flowering hybrids such as 'Gloire de Versailles' and 'Topaz.' All are sun lovers and the majority in the British climate need the protection of a sunny wall. Another Californian which usually needs wall protection is *Carpenteria californica*, an evergreen bushy shrub with large fragrant white flowers often 3 inches across. Mexico is the home of the shrubby perennial *Penstemon isophyllus*. This plant bears loose racemes of brilliant crimson flowers continuously from July until cut by the frost; it is best treated as a herbaceous plant and thus should be cut down to within 6 inches of the ground each spring. Also crimson flowered is the Chilean *Berberidopsis corallina* which can be planted against a wall or in the more favoured gardens may be allowed to ramble among Rhododendrons. *Campsis*, close ally of *Tecoma* and *Bignonia*, is a genus of two species, both of them handsome woody climbers. The American *C. radicans* with rich scarlet and orange flowers of trumpet shape and up to 3 inches long supports itself, Ivy-like, by aerial roots. The Chinese *C. chinensis* is not so self-supporting, but the flowers of similar colour though more open at the mouth, are even finer than those of the other species. These plants should always be planted against a sunny wall. At Wisley they climb the laboratory walls as does the hybrid between them which is called *C.* × *Tagliabuana*.

Of the members of the Magnoliaceae, *Drimys Winteri*, from South America, with milk-white jasmine-scented flowers and with attractive winter foliage and bark, can be grown against a wall, but is apt to be cut severely back in the winter. The hybrid between *Magnolia denudata* and *M. liliflora*, *M.* × *Soulangiana*, is well known. Of course, a wall is not necessary for its successful cultivation, but it is an excellent plant for covering a wall. The specimen growing on the frameyard wall, *M.* × *Soulangiana* 'rustica rubra,' commences to open its flowers, white within and purplish stained without, before the leaves appear. Whether or not these flowers are an ornament to this particular red brick wall is a matter of opinion. No matter, the plant is very attractive in the autumn when the green seed pods ripen and split to reveal the scarlet seeds. The evergreen American *M. grandiflora* frequently to be seen on walls, especially on some of the older houses in the country, is found at Wisley growing as an upright pyramidal bush some 15 feet high and as much across.

Feijoa is a monotypic genus of the family Myrtaceae and the solitary species, *F. Sellowiana*, a Brazilian evergreen, has petals of white with centres of red. In Cornwall it may be grown in the open, but in the average British climate it is happiest against a sunny wall. The genus *Myrtus* is represented by the form of *M. communis* known as *tarentina* which has small leaves and makes a free-flowering compact plant.

Though *M. communis* is the hardiest species even it requires a wall; the others should be given greenhouse conditions.

Growing next to this form of the common Myrtle is the Chinese *Abelia Schumannii*. This plant makes a well-sized shrub of 4 to 5 feet in height and carries graceful arching purple-coloured branches with rosy pink broadly funnel-shaped corollas from July until the first frosts. Of similar habit is *A.* × *grandiflora*, a hybrid between *A. chinensis* and *A. uniflora*, with white flowers tinged with pink. Both these plants are hardy, in all except the severest winters, when planted at the foot of a wall or in some other protected position.

Of the family Saxifragaceae we observe *Hydrangea petiolaris*, hailing from Japan and clinging to the wall by aerial roots like the Ivy. The white flowers are borne in corymbs up to 10 inches in width. The closely allied *Schizophragma integrifolia* is a Chinese plant with corymbs of similar size although the individual flowers are considerably smaller. The great beauty of the inflorescence lies in the large-stalked white bracts.

Also from Eastern Asia is *Caryopteris incana* (syn. *C. Mastacanthus*), with violet-blue flowers; this plant needs the protection of the wall but the hybrid between this species and *C. mongholica*, known as *C.* × *clandonensis*, is somewhat hardier and has bright blue flowers which contrast well with the greyish undersurface of the leaves. This genus is a member of the family Verbenaceae as is *Clerodendron Bungei*, a half hardy shrub usually killed to the ground each winter. The fragrant flowers of purplish red are borne in loose terminal clusters and the foliage is evil smelling when crushed.

From New Zealand come many choice plants suitable for a protected position. There is the June-flowering *Veronica Hulkeana* with delicate lavender-coloured flowers borne in panicles up to 8 inches long. There is *Senecio laxifolius*, which is somewhat more hardy and has golden yellow flowers set against grey-white obovate leaves.

Finally, on the laboratory wall, we may note the Australian Silver Wattle, *Acacia dealbata*, whose fragrant clear yellow flowers combine so charmingly with the beautiful silvery feathery foliage. In a garden so cold as Wisley it cannot be grown so magnificently as in certain gardens in Cornwall, Devon and Ireland. But in its present position it does grow and it does flower even though a hard winter severely cuts it back.

MASTERS MEMORIAL LECTURE, 1953

THE CONTROL OF FLOWERING BY DAYLENGTH AND TEMPERATURE

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PART I

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THE question which I shall discuss in these lectures concerns the factors controlling the flowering of plants. The flower represents the final term in the process of development or ontogeny of higher plants and marks the beginning of the reproductive phase leading to fruiting and seed production. The vegetative phase which necessarily precedes flowering is concerned with the development of the structural framework on which the flowers are carried, the leaves necessary for the elaboration of the organic carbon compounds, the roots for the supply of inorganic nutrients and water. The orderly process of development is ultimately controlled by the genes in the nuclei of the cells, and this mechanism is already present in the fertilized ovum from which the embryo in the seed is derived. Given the appropriate environment, the sequence of growth processes proceeds and culminates in production of flowers. The genetic make-up of the plant thus provides the potentiality for flowering, but the realization of these potentialities is under the control of the environmental factors.

Botanically speaking the flower is a modified branch of limited growth bearing modified leaves in the form of sepals, and petals and reproductive organs. The flower originates in the axil of a foliage leaf or a reduced leaf or bract, and arises in definite regions of the plant and not sporadically. Flower buds usually appear on stem structures, very rarely on true leaves, and never directly on roots. Even in cases of cauliflory, as in the Cocoa, where massive inflorescences are borne on the woody trunk, the meristem from which they are formed can be traced to the axil of a leaf long since shed.

Flowers and inflorescences may thus appear terminally on the stem, or laterally in the axils of foliage leaves: in the former case the flowering region is sharply separated from the vegetative regions of the plant, in the latter they overlap. With terminal inflorescences there is a succession of vegetative and reproductive phases; in the latter the phases may overlap or coincide.

In the analysis of the process of flowering we may distinguish between internal and external factors. *Internal factors* include the

genetic constitution of the plant, which I have already mentioned, nutritive factors and hormones. The *external factors* include temperature, light and manurial factors including water supply. These two sets of factors are not, of course, distinct in nature, as complex interactions occur.

As the title of my lectures indicates I shall concern myself mainly with the external factors; the internal factors I shall only cursorily mention.

First the genetic factors. Genetically we can distinguish various types of plants: thus annual, biennial and perennial. Within the same species both annual and biennial forms occur which are genetically distinct and on hybridizing give segregating progeny. As we shall see, by suitable change in environment biennials can be made to behave like annuals. The time taken to reach flowering varies greatly, and the question arises whether there is evidence of puberty in plants as in animals.

The further question arises whether the control of flowering is accomplished by the production of special hormones, and if so whether these are positive in their action, i.e. actively promoting flowering, or if, on the other hand, they are inhibitory preventing the production of flowers in the normal way.

With the rise of plant physiology in the nineteenth century attention was directed towards the problem of flowering, and in 1865 SACHS brought forward evidence that "flower-forming substances" or as we should now say, flowering hormones, are formed in light in the leaves, and are translocated to the sites at which flowers are produced. At that time these speculations were not well received, and the matter was allowed to drop. It was supposed that the so-called "formative substances" consisting of carbohydrate and nitrogen compounds were adequate to explain flower formation without invoking indefinite and mythical "flower forming" substances. Scepticism, always healthy in science, in this case held up progress for nearly a hundred years.

Whether the genes in the cell nucleus are immune from control by the environment is a matter of heated controversy across the "iron curtain"; the concensus of opinion in the West is that this is the case, although LYSENKO has challenged this view, and I shall later mention his work. If immunity of the genes is the truth it would mean that all the genetic factors are present in the fertilized ovum, and therefore if the external factors are such that no flowering occurs there must be inhibiting factors at work, and we might discuss our problems in terms of "failure to flower" rather than "promotion of flowering."

The rational approach to the problem may be stated in the following terms: if flowering fails what happens in the growing points where the flower initials normally appear; this can be settled only by dissection and observation, and is the method first employed by DR. PURVIS in my laboratory.

The rigid analysis of the factors controlling flowering began with

the researches of KLEBS in 1918 on *Sempervivum funkii*. Using rosettes of the plant he noted the following important facts: first by the use of continuous artificial light "forced" flowering could be achieved in winter; second, that this was true only of rosettes above a critical size. He therefore distinguished a definite stage in development which must be reached before any treatment could induce flowering. This stage he called "ripeness to flower"; he might have called it puberty. This size effect is well known in the bulbous plants, for bulbs below a certain size produce no flowers. HEATH and HOLDSWORTH showed in the onion that large sets would fail to flower on forcing if the outer bulb scales were removed, even though the resulting artificial small bulb was of a size above the critical. They concluded that some factor essential for flowering was stored in the bulb scales, and had been removed by the operation.

KLEBS also found with *S. funkii* that the longer the start of continuous light was delayed the greater the tendency to flower became: thus in November nine days of continuous light were needed to induce flowering, in April only one. By growing rosettes at varying distances from the source of continuous light (1,000 foot-candles) and thus at varying intensities KLEBS showed that below a critical intensity flower buds were formed but failed to develop further and aborted. KLEBS therefore distinguished three stages in flowering: (1) ripeness to flower (or puberty); (2) initiation of flower rudiments or primordia; (3) further development of the flower buds and ultimate opening. He found the minimal intensity of continuous light necessary for initiation to be very low; less than 1 foot-candle. Also he found that the quantity of light received was not the determining factor; thus continuous light of $\frac{1}{2}$ foot-candle caused initiation, whereas 12 hours of light per day at 200 foot-candles failed, although this is equivalent to 200 times as much total light. KLEBS concluded from his experiment that the interruption caused by the interval of 12 hours' darkness had an inhibitory effect. This inhibiting effect of darkness, however, was dependent upon temperature, low temperature preventing dark inhibition. At 30° C. (86° F.) darkness rapidly destroyed the ripeness to flower condition; at temperatures about 0° C. (32° F.) ripeness to flower was maintained for over nine months.

KLEBS concluded from his work that flowering depends upon the accumulation of sugars and other carbohydrates, which are destroyed by respiration in the dark. Thus he thought that nutritive factors determine flowering. Since, however, very low light is sufficient to induce flowering, the facts do not support this view. It would seem that some stimulus is needed for flower initiation. This view that the level of carbohydrates relative to the nitrogen compounds play a determining part in flower induction has been widely held, but the variations in C/N ratio are a consequence not a cause of flowering. There seems little evidence that starvation of nitrogen is conducive to flowering; KLEBS drew attention to the effects of temperature and light

and their interaction, and the remainder of this lecture is to be devoted to the effects of light; temperature I shall deal with later.

In the course of his work with Sempervivum KLEBS noted that at various places in Germany the rosettes always flowered at approximately the same time (April 26–30) quite irrespective of the general temperature levels. He overlooked the importance of this observation. It is, of course, a matter of common knowledge that certain species flower in spring or autumn when the days are short, others in summer when daylength reaches its maximum. Until recently the seasonal variation in flowering was regarded as a consequence of temperature changes during the year, and the fact that by raising the temperature during the winter in greenhouses certain plants can be forced into flower lends support to this view. Nevertheless this is not by any means the full explanation of seasonal flowering.

Light as an external factor has three aspects: (1) Intensity, (2) Quality (or colour), and (3) Duration, all of which play their part in control of flowering.

The importance of daylength, i.e. the relative length of day and night which changes with the seasons, was not realized until quite recently. It is true that JOHN RAY in the eighteenth century was aware of this effect of daylength, and TOURNOIS, a French physiologist who lost his life in the First World War, had shown by experiments in 1912 that reducing daylength led to precocious flowering in certain plants, yet not until 1920 was this fact fully established by the American physiologists GARNER and ALLARD. The behaviour of a mutant Tobacco variety 'Maryland Mammoth' led to this discovery. Unlike other varieties of Tobacco this plant failed to flower in the summer, and since it was not frost hardy the plants were removed to a greenhouse in autumn; it was then found that they ceased to form leaves and flowered in the short days of November. Seeds were produced and sown immediately. The seedlings grown in winter rapidly came into flower, and serial sowings showed that after a certain date in spring the habit of the plants changed; they grew tall and ceased to flower. This effect was shown to be largely independent of light intensity, temperature, and humidity, but related to the length of the day. This effect of daylength GARNER and ALLARD called Photoperiodism.

GARNER and ALLARD distinguished three categories: (1) Daylength indifferent, (2) long-day, and (3) short-day plants.

(1) Daylength indifferent plants, include those which like *Stellaria media*, *Cerasus avium*, or Syringa will flower at any season so long as temperature and light intensity permit; and those which having ample storage organs, will initiate flowers in complete darkness, such as the Potato, and bulbous plants.

(2) Short-day plants are those which demand a long dark period for flower initiation; they might more appropriately be called long-night plants. Tropical plants in the main fall into this category. CHOUARD has subdivided them into obligate and facultative short-day plants;

the former such as *Perilla ocymoides* never initiate flowers if the dark period falls short of a critical duration. A minimum exposure to light is required to allow growth to proceed, but this is a question of total light received and not of a definite duration. The facultative short-day plants such as the Soy Bean and winter cereals initiate flowers more quickly in short days, but eventually do so even in long days.

(3) Long-day plants also can be subdivided into obligate and facultative types. The former such as *Oenothera biennis*, *Anagallis arvensis*, *Calluna vulgaris* fail to initiate flowers if the daily exposure to light falls below a critical value, and flower soonest in continuous light. The facultative long-day plant such as the spring cereals, *Arabidopsis thaliana* among annuals, and *Brunella vulgaris* among perennials, flower more rapidly in long days but will eventually flower in short days.

Plants with more complex relation to light and darkness are also known: thus e.g. the Tomato, in which flowering is only delayed by either long days or nights, or even inhibited by continuous light. Again there are plants such as *Mikania scandens* with critical light and dark periods, which therefore only flowers within a narrow range of 11–13 hours' day, and 13–11 hours' night.

We will now consider in some detail the photoperiodic behaviour of the obligate short- and long-day plants.

The outstanding fact with regard to these plants is the existence of a critical daylength, which may vary over a wide range. If by increasing the daylength above the critical duration flowering is prevented, the plant is classed as a short-day plant. Thus *Xanthium pennsylvanicum* studied by HAMNER has a critical daylength of 18½ hours, and if daylength is increased beyond this point flowering fails; we may equally well say that Xanthium requires a dark period longer than 5½ hours. Most short-day plants require a longer night, thus 'Biloxi' Soy Bean requires at least 10 hours of darkness. The obligate long-day plant requires no darkness at all, and flowers soonest in continuous light, but fails to flower if daylength is reduced below the critical value. Within a given species both long- and short-day plants occur. Thus *Nicotiana tabaccum* var. 'Maryland Mammoth' is a typical short-day, *N. sylvestris* a typical long-day plant.

Within a species variations in critical daylength are found: thus the Soy Bean var. 'Biloxi' flowers in long days in 4 months, var. 'Mandarin' in 28 days, but when grown with daily light of 12 hours 'Biloxi' flowers in 28 days, and 'Mandarin' in 21 days. The difference between early and late varieties may thus be eliminated by altering the daylength.

By manipulating the daylength plants may be induced to flower twice in a season; thus Soy Beans kept in short days rapidly flower and in the short autumn days the plants again flower at the same time as others sown late (in long summer days) and flowering for the first time.

The intensity of the light required to induce flowering in short-day plants is very low; 1 foot-candle is quite sufficient; even moonlight

has been shown to have some effect. By the use of artificial light the daylength can be prolonged to prevent flowering in short-day plants or induce flowering in long-day plants. Thus *Cosmos bipinnatus* was sown in autumn and grown in the short days of winter in the greenhouse. The controls flowered, but the plants given artificial light to midnight remained vegetative. In spring when the daylength had exceeded 12 hours the artificial light was discontinued. The plants grew vegetatively throughout summer and came into flower in autumn by which time they had reached the height of 15 feet instead of the 30 inches of the controls.

Long-day plants can be made to flower in short winter days by the use of artificial light of low intensity of the order of 100 foot-candles; on the other hand by shortening the natural daylength the long-day plants can be kept vegetative for long periods. Thus *Sedum spectabile* was kept vegetative for nine years, but after this given a few normal summer days, flowered at the same time as the controls which had flowered normally each year. Again, the bolting of Spinach can be prevented by giving 7-hour days.

QUALITY

Besides duration of light, the quality or colour of the light is of supreme importance. RAZUMOV in 1933 first showed that photoperiodic effects were brought about by red light which promotes flowering in long-day plants, and prevents it in short-day plants. Neon light is particularly effective. White light is always effective and green almost always behaves like darkness. FUNKE (1936) has, however, shown varied behaviour among plants. Sometimes as in long-day plants *Centaurea cyanus*, *Teucrium chamaedrys* and short-day *Perilla ocymoides* both red and blue light have positive effects.

Most crucifers appear to require blue light, red acting as darkness; examples are *Alyssum calicynum*, *Iberis amara*, *Nasturtium silvestre* (S.D.). Finally a few plants are known in which white light only is effective, both red and blue acting like darkness; examples are *Gnaphalium lanceolatum*, *Lepidium draba*.

PHOTOPERIODIC INDUCTION

It was first shown by EGHIZ in 1928 that the effective photoperiod need not be given throughout the vegetative phase, but that after a limited number of cycles the plant may be transferred to unfavourable daylength and yet come into flower: flowering may therefore be an after-effect of a previous treatment: a phenomenon known as photoperiodic induction. An example is the facultative short-day cereal Millet studied by RAZUMOV in 1930. Grown throughout in days of 18 hours' light the plants flowered in 51 days; kept throughout in 12-hour days flowering occurred in 23 days, but when short days were given for 6 days at the start the plants flowered almost as soon as in long days, actually in 26 days. No after-effect however was shown by 3 short

days at the start: the plant seems then to be indifferent to daylength. The whole effect occurs between the 3rd and 6th day after germination. An extreme case is that of *Xanthium pennsylvanicum* which after given one long dark period will then flower even in continuous light.

A similar induction effect occurs in long-day plants; thus the annual Beet given 14 or more long days of 19–21 hours afterwards flowers when transferred to short days of 8 hours. Arabidopsis, a facultative long-day plant, requires only 2 days of continuous light for full induction.

SUMMATION EFFECTS OF DAYLENGTH

We have already seen that short-day plants have a critical dark period, which must be exceeded, and long-day plants a critical dark period which must *not* be exceeded if flower induction is to occur. If cycles are given within the critical range, however, the effects on flowering are additive and summation occurs.

Thus in the short-day plant Soy Bean, HAMNER showed that given preliminary cycles of 9 hours' light and 15 hours' dark before removal to continuous light the number of flower buds produced was proportional to the number of short cycles given, varying from seven buds after two such cycles to fifty-six buds after seven cycles. A similar result was obtained by MELCHERS with the long-day annual variety of *Hyoscyamus niger*. This plant has a critical daylength at 22° C. of 10 hours 40 minutes; in a 10-hour day the plant remained vegetative for 125 days, which shows how precise the photoperiodic requirements are. In continuous light flower initials, as shown by dissection of the growing point, appeared after three cycles, in 16-hour days after four cycles, and in 12-hour days after nine such cycles. In the same way if the light intensity is too low to induce flowering in a limited number of cycles the effects will summate and eventually lead to flower induction.

INTERRUPTION OF DARK PERIOD IN SHORT-DAY PLANTS

Perhaps the most remarkable effect is that obtained when the dark period in short-day plants is interrupted by a short exposure to light. This was studied in detail by HARDER in 1943, using *Kalanchoe Blossfeldiana*. In this plant a dark period of 11 hours fails to induce flowers, but cycles of 15 hours' darkness and 9 hours' light are fully effective. Using this photoperiod HARDER interrupted the dark period with 1 minute of light given at various times after darkening the plants. When the interruption is given at the middle of the dark period flower induction fails completely, but interruptions given earlier or later have progressively less effect, and therefore the number of flower buds formed varies from 400 to zero and again increases as the time of interruption is moved forward during the dark period. The intensity of light used is important; with interruptions of 1 minute at mid-point of the dark period using 30 foot-candles flower number falls from 250 to 190; with 70 foot-candles to 17, and with 1,000 foot-candles to zero. This effect has been used in horticultural practice for delaying

the opening of the flower buds of the Chrysanthemum, which requires short days, by a short interruption during the night with artificial light of quite low intensity.

THE PERCEPTION OF THE LIGHT STIMULUS

The question may now be raised as to how the light stimulus is perceived: whether directly in the growing point or elsewhere in the plant. This question can be decisively answered. It is known with certainty that the leaves in both long- and short-day plants perceive the light stimulus, as first shown in the Spinach (L.D.) by KNOTT in 1934, and in the Chrysanthemum (S.D.) by CAJLACHJAN and MOSKOV (1936). It is quite generally true. In Xanthium, HAMNER (1938) has shown that it is the mature fully expanded leaves which are active, plants with only young expanding leaves left on or completely defoliated are quite indifferent. Since the initial reaction takes place in the leaf, but the final reaction in the growing points where flowers are initiated, it is clear that the stimulus must pass through the plant. The question of transmission or localization of photoperiodic effects is thus raised. In their early work GARNER and ALLARD using *Cosmos bipinnatus* concluded that the effect of photoperiods are strictly localized. They used two branches on the same plant, one given short days the other long days: only the branch in short days flowered. Again different portions of the main stem reacted independently. The only exception was found when the apex of the plant was kept in complete darkness, for then transmission of the stimulus from below occurred.

We now know that the conclusion that local effects only are produced is incorrect. Thus HAMNER and BONNER (1935) showed that in Xanthium the stimulus readily passes throughout the plant. Using two branches, one kept in short days (the donor branch), the other in continuous light (the receptor), when the donor was given one long dark period the receptor initiated flowers even in continuous light, and after the donor branch had been removed. By varying the time before removal of the donor the rate of transmission of the stimulus could be estimated. It is significant that in this case the reaction of the receptor branch was increased when all mature leaves were removed. In the case of the Soy Bean, in a similar experiment, no transfer of the stimulus occurred *unless* all mature leaves of the receptor branch were removed, or the branch kept in complete darkness. Clearly in Soy Bean and Cosmos either localization can occur as GARNER and ALLARD found, or transmission to other parts, according as the mature leaves are present or absent, or the responsive portions kept in complete darkness. The stimulus has been shown to pass across a graft so long as union of the tissues has occurred.

It has been shown by HAMNER in Xanthium and by HARDER in *Kalanchoe Blossfeldiana* that a single leaf on the plant given short days can lead to flowering though the remainder of the plant is kept in long days, but induction is reduced by the presence of leaves in long days if

these are inserted above the single treated leaf. MOSKOV with Perilla, and HARDER with Kalanchoe showed that if the distal half of the leaf is given short day the proximal half long day no induction occurs, whereas in reverse case the induction succeeds. There is thus no doubt that in short-day plants the leaf illuminated for longer than the critical light period destroys the stimulus to flower initiation.

THE MECHANISM OF PHOTOPERIODISM

The salient facts of photoperiodism have now been briefly presented. The question naturally arises what in fact occurs during photoperiodic induction and what is known of the physiological processes involved.

Before attempting to give an answer let me summarize the main facts. The short-day plant for successful initiation of flowers requires a minimum period of darkness, which must be uninterrupted. In a normal 24-hour cycle there is a critical duration of the light and dark phases for initiation to occur. By extending the light period beyond the critical by even very low intensity light of the order of 1 foot-candle induction is prevented. By interrupting the dark period by a light break (a single flash of light of high intensity suffices in Kalanchoe) induction is prevented. The mature leaves in darkness are the seat of the reaction leading to initiation; leaves kept in light hinder the transmission of the stimulus.

Summation of the effects of photoperiods occurs, so that something must be conserved from successive dark periods. What then is the nature of the stimulus ?

The simplest hypothesis is that some substance is produced in the darkened leaf, which is transmitted to the growing points and leads to flower initiation. By experiments, of which time will not permit detailed description, it has been shown that in a plant like Xanthium, which, it will be remembered, requires only one long dark period of greater than 12 hours, for the dark period to be effective, it must be preceded by a light period. This suggests that some substances formed in the light is, by a chemical reaction in darkness, converted into the effective stimulating substance. Since CO_2 must be given during the light period it has been assumed that photosynthesis is concerned in the process. Quite recently, however, it has been shown that CO_2 can be fixed in the dark in Kalanchoe if kept in short days, and therefore CO_2 may be even more necessary during the dark period so long as the plants are kept in short days. In Kalanchoe plants kept in long days little or no dark fixation of CO_2 occurs. This substance formed in darkness in the leaf is evidently removed by a very short exposure to light: as to what happens to it is not known with certainty. My own view is that the reaction which forms it is reversed by light, so that if the dark period is interrupted by light soon after the dark has begun there is still time for the active substance to reform; but if the interruption is given 10 hours after darkening the destructive effect of light is maximal. In Kalanchoe this in fact is the case, while with interruptions

given still later the effect on flower induction again decreases. I suggest that this is because after the end of the critical dark period, the active substance is transported away from the leaf, and then is not affected by light. If, however, the substance is still in the leaf when the dark period ends it is then destroyed. This would explain the appearance of a critical dark period. This, however, is not the whole story for if the light period is extended beyond the critical duration and the plant is then given a dark period normally adequate for induction no flowering in fact occurs. Thus Kalanchoe kept in 19-hour days fails to flower however long the following dark period is made. It would therefore appear that the precursor of the reaction in dark has been lost: I suggest that in light it is converted into a leaf-forming hormone, and in fact whenever flowering is delayed leaves are formed in the growing points, and in Kalanchoe the tiny bracts which normally subtend the flowers are under these conditions converted into normal foliage leaves.

Other theories have been proposed, but perhaps, not unnaturally, I prefer my own, and this is not the occasion for scientific polemics.

Turning now to the long-day plants the conditions there are almost exactly the reverse from the short-day plant. Here again the leaves perceive the stimulus, but it is now leaves in darkness which inhibit flower induction. In *Hyoscyamus niger* (annual variety) MELCHERS and LANG have shown that if all leaves, including the immature leaves at the apex, are removed the plant will initiate flowers in complete darkness; this behaviour is associated with a storage root and only occurs when the root is above a minimum size. With leaves present, darkness, if too prolonged, inhibits flowering. Hence there is a critical dark period, but even short dark phases reduce flowering as we have seen. True long-day plants flower earliest without any dark period in continuous light.

In the long-day plants interruption of the dark period by a short exposure to light eliminates the inhibitory effect of darkness and the plants behave as if they were in long days. The interruption required to be effective is much longer than in the case of short-day plants. The explanation of this effect is by no means certain; there is some evidence that after a period of darkness, if not too prolonged, the following light period is more effective suggesting that a preparatory reaction can occur in darkness. I have had to omit a great many facts which complicate the story still more, but this in a short lecture is inevitable. The explanation for photoperiodism I have put forward is in terms of specific substances, and goes back to the suggestion made by SACHS nearly a century ago. I shall return again to the question of the existence of flowering hormones and then present evidence on this matter.

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THE 1952 EXPEDITION TO WESTERN NEPAL

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(*Based on Lecture given on March* 3, 1953; LORD ABERCONWAY, C.B.E., LL.D., D.SC., V.M.H., *in the Chair*)

IN 1952 it was our good fortune to be allowed to fill to some extent another of the few remaining blanks on the botanical map of the world, an area of 1,000 square miles lying between the Karnali and Kali Gandaki rivers in western Nepal. That this part of the Nepal Himalaya was likely to be a source of new garden plants had been shown by the several new or otherwise desirable species discovered and introduced by LALL DHWOJ and K. N. SHARMA who had collected farther to the east during the nineteen thirties. Botanically Nepal is of particular interest, for it is here that the differing floras of the eastern and western Himalayas merge. With the object of collecting both herbarium specimens and plants suitable for gardens, the expedition was organized by the British Museum (Natural History) and The Royal Horticultural Society.

OLEG POLUNIN, who had been to central Nepal in 1949 and who published an account of his journey in the JOURNAL of The Royal Horticultural Society, **75**, 304 (1950), leavened the inexperience of WILLIAM SYKES and myself who were both new to the Himalayas. As a member of the staff of The Royal Horticultural Society Gardens at Wisley, SYKES was to train as a botanical and horticultural collector.

In the field we were assisted by six native collectors, some of whom had been on collecting journeys with both LUDLOW and SHERRIFF and KINGDON-WARD. These men showed tremendous enthusiasm for the work of the expedition and any success we may have achieved is in no small way due to their efforts.

The Government of Nepal kindly granted permission for entry into their country and throughout our stay we received considerable assistance from their provincial officers. We left England at the end of February with our six tents and more than thirty light but strong plywood boxes containing botanical collecting material, our clothing and equipment and a supply of tinned food for the seven and a half months which we should spend in Nepal. These boxes had been packed so that none of them exceeded 70 pounds in weight and would thus make convenient coolie loads. From Bombay we crossed India by rail to the small branch line terminus of Jarwa, a few miles south of the Nepal border which we crossed on March 22.

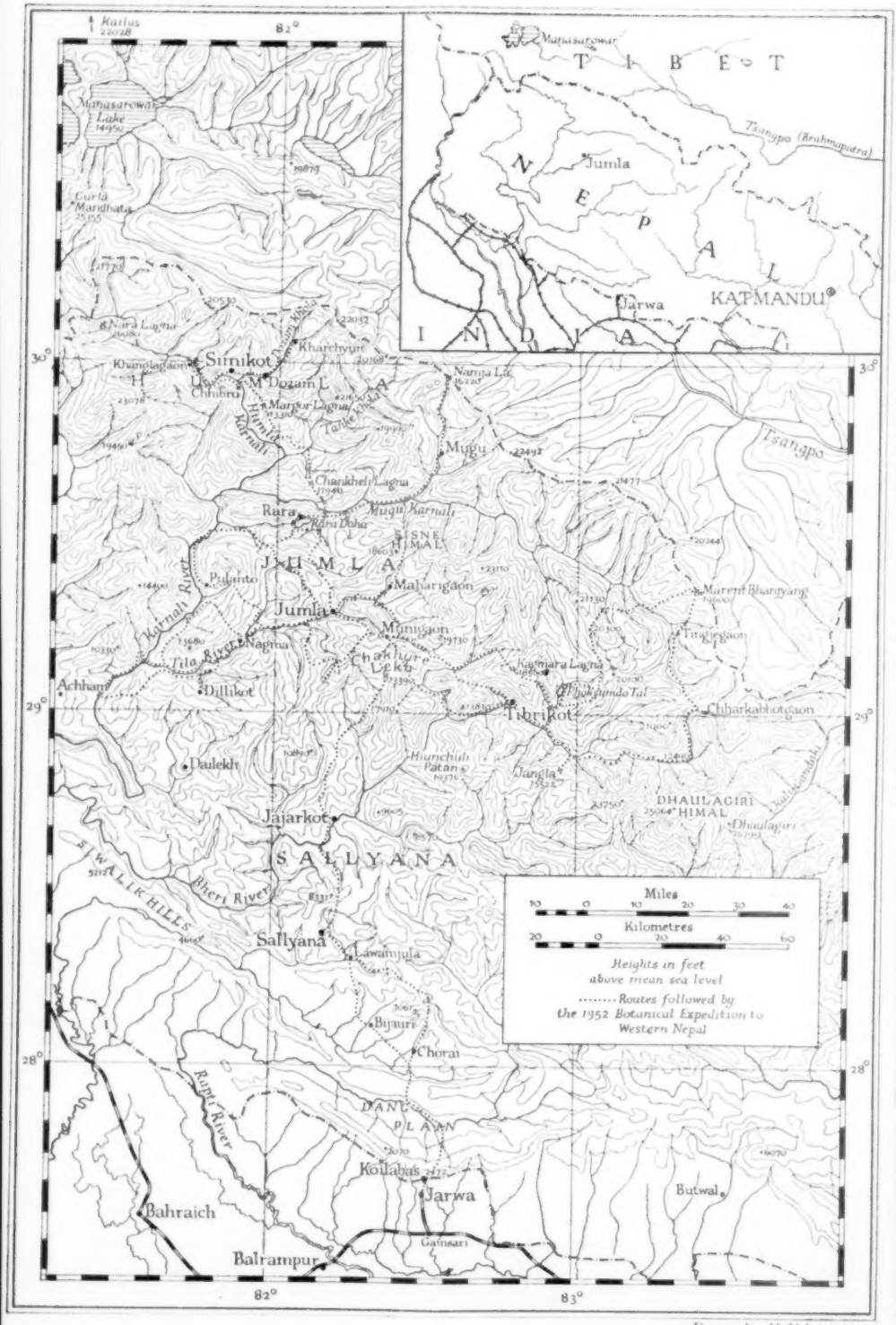
The general plan of the expedition was to make direct for Jumla and using this village as our base, to work as three parties so that as much ground as possible could be covered. Each party was to consist of one European with two native collectors. The Nepalese Government provided each party with an escort of three or four sepoys under the orders of a havildar and we found these men invaluable not only for their help in the often difficult task of obtaining coolies and food but also in assisting with the daily drying of our plant press papers. For food we relied on local supplies as much as possible; rice, chickens, eggs and flour were usually fairly easily obtainable but milk, curds and especially butter were often extremely difficult and the dried milk and tinned butter which we had brought proved invaluable. Occasionally we were able to obtain honey produced in primitive hollow log hives. This honey varied in the amount of wax and the number of larvae and bees' legs and heads which it contained but it was at least sweet and satisfied the craving for sweetness which is experienced at higher altitudes.

The march of nearly 150 miles to Jumla took 18 days and brought us into training for the harder days ahead in the main Himalayan range. After crossing the Siwalik ridges and fording the Rapti, the Dang plain was the last level country we were to see for many months. On the north side of this plain, an extensive Rice-growing area with tall Bamboos, Mango groves and Papaws, the foothills of the Himalayas rise abruptly to between 6,000 and 7,000 feet. Northwards from this first ridge the country is just a tumbled mass of hills, valleys and mountains, becoming ever higher until the crest of the main Himalayan range is reached. North of the main range lies another high ridge also with many peaks of over 20,000 feet, the so-called Ladakh range which for some distance lies along the northern border of Nepal. North again of this lies the dry plateau of Tibet, screened from the monsoon rains by the high mountains to the south.

From the crest of the first ridge we were confronted with a remarkable vista across nearly 100 miles of rugged country with the glistening snow covered massifs of the Dhaulagiri Himal and Annapurna rising against the intensely blue sky. On this ridge as on the many others which were to follow, were forests of evergreen Oak (*Quercus incana*) and *Rhododendron arboreum*; the latter often over 30 feet in height and with a trunk as much as 2 feet in diameter, was covered in innumerable trusses of brilliant scarlet flowers while on its moss-covered trunks grew many epiphytic Ferns and Orchids. At between 8,000 and 10,000 feet *R. arboreum* differed considerably from this lower altitude form in having flowers always pink in many varying shades. Here and there, among the Rhododendrons and Oaks, 8-foot high bushes of *Berberis asiatica* were yellow with blossom and the ground beneath was starred with the minute blue flowers of a small annual Gentian.

Six days' marching from the Indian border brought us to Sallyana where we were hospitably entertained by the Governor of Sallyana Province before proceeding on our way with a new escorting party who continued with the difficult task of finding sufficient coolies for our forty-two loads. Often only by drawing upon the manpower of several adjacent villages were sufficient men obtainable. From the ridge north of Sallyana we again enjoyed superb views framed in the scarlet blossoms of the tree Rhododendrons and could see ahead of us the snow-covered pass over Chakhure Lekh which we should soon have to cross, while farther to the east rose the isolated and graceful 19,000-foot peak of Hiunchuli Patan, an outlier of the Dhaulagiri Himal. From this ridge we descended to the hot valley of the Bheri river, 5,000 feet below. To our extreme surprise we crossed this river by a steel suspension bridge bearing the name of an Aberdeen engineering company. It had been carried by coolies piece by piece over the sixty miles of rugged country from the Indian border and erected here by Indian engineers. Not far from this bridge, on the north bank of the Bheri we came to the town of Jajarkot, built upon the summit of a conical hill, with rust-red brick houses, many of which had tiled roofs. The gardens were gay with Marigolds and Roses, and Papaws and Bananas were also grown. A great marquee-like tent which was roomy enough for all three of us besides all our forty-two loads was erected for us beside the Hindu temple. The Hindu festival of Holi was being celebrated when we arrived and the townspeople were all dressed in their most colourful clothing, while many wore garlands of flowers. Presents of rice, clarified butter and pulse were sent to us by the Rajah of Jajarkot but the best we could send in return was a thermos flask and a few packets of tea.

The valley north of Jajarkot along which our route continued supported much subtropical forest. One conspicuous shrub was *Woodfordia fruticosa* with flowers of a bright orange-red which vied with the flaming red flowers of *Erythrina suberosa*, a tree of 40 to 50 feet which blooms before the leaves expand and which is armed with vicious-looking prickles. As we climbed out of this valley we refreshed ourselves



Drawn by V. Nehring

by a bathe in a pool in a tumbling hill stream. Here, growing on half-submerged boulders and looking rather like a moss, we found a member of the *Podostemaceae*, probably *Hydrobryum Griffithii*, which had not hitherto been found so far westward in the Himalaya.

Our route continued up and down, through cultivated valleys and over hills of Rhododendron and Oak forest, each crest higher than the last until at between 8,000 and 9,000 feet we reached the damp Tsuga forest which lines the lower slopes of the Lesser Himalaya. Here, early in April, we found our first Primula, a stunted form of *Primula denticulata* and here too in wet shady gullies was the lush spring growth of *Cardiocrinum giganteum* with the 6-foot-high dry flowering stems of the previous season still erect. Several species of Berberis were opening their drooping yellow flowers and *Rhododendron barbatum*, a large spreading shrub with bark of a warm pink-brown, bore trusses of translucent red flowers. Two really lovely shrubs, both of which flowered before their leaves unfolded and which from a short distance looked very similar, were *Daphne Bholua* var. *glacialis* and *Viburnum grandiflorum*, seeming to light up the shade of the forest with their abundant pale pink flowers. In one place only, on the very edge of the Tsuga forest, we found a single tree of the Carmine Cherry, *Prunus cerasoides* var. *rubea*, some 40 feet high and bearing large drooping scarlet flowers. Near here a primitive furnace was in operation smelting the rich iron ore which composed the whole face of one hillside. Mining was quite unnecessary, the ore merely had to be picked up and carried away in baskets. The furnace, built of clay and charged with lumps of ore and charcoal, was blown by two villagers alternately squeezing and filling two bellows consisting of goat skins with a hand-operated valve at one end.

At Maina we had to halt for a day so that sufficient coolies for our next stage could be recruited. Previously we had been employing a fresh party of coolies each day but to cross Chakhure Lekh for three days we should be passing through country without any villages and the men from Maina would have to come with us the whole way. The sepoys went out to the nearby villages and eventually the requisite number of men was found. We spent the day repacking some of our stores and collecting in the vicinity. The material of our tents, which we used here for the first time, aroused considerable interest among the local people who also pounced upon any scraps of paper which we might throw away, seeming to regard them as of great value.

Two days' marching from Maina brought us to the southern flank of Chakhure Lekh where we found several winter rosettes of *Meconopsis regia*, the pale green leaves densely covered in glistening, silky, light brown hairs. We camped at 12,000 feet on the very edge of the snow and in the light of a full moon started on our way over the pass at 3.30 the next morning, while the snow was still hard enough to support our weight. Once the sun beats upon the snow it becomes so soft that one sinks in deeply at every step. We reached the summit of the pass

which is only 13,390 feet just as the sun rose and the moon sank down over the hills to the west. The view which confronted us to the north was unforgettably lovely, with the early morning sun lighting up a vast confusion of snow-covered ridges and mountains right up to the borders of Tibet and beyond. Far away to the north-west, gleaming white and immense, rose the majestic mass of Gurla Mandhata (25,355 feet) more than 100 miles away in Tibet, near the sacred lake of Manasarowar and Mount Kailas. We crossed the pass in the company of hundreds of sheep and goats carrying loads of flour from southern Nepal in small bags slung on either side of their backs. Each flock was accompanied by its shepherd and his dog and with one of these dogs there was a tiny woolly puppy which, floundering in the snow, seemed yet smaller amid all this immensity and grandeur. Snow was lying at lower altitudes on the northern flank of the pass and the going became rather difficult as the sun's strength increased. The leafless branches of *Betula utilis* with their tattered flaking bark blowing in the wind caught the bright sunlight reflected from the snow beneath and gave the trees an appearance of unreality. Among the Himalayan Birch, bushes of *Rhododendron campanulatum* began to appear above the melting snow; in contrast to the lightness of the Birches was the dark green of the gaunt trees of *Abies spectabilis* with trailing pale green lichen hanging from every branch. Lower down came forest of *Pinus Chylla* and *Picea Smithiana*, both magnificent trees often exceeding 150 feet in height. This memorable day's march ended at Munigaon where we spent the night in a flat-roofed house built of stone and massive timbers. It was completely open on one side and had two windowless, dark and smoky mud-walled rooms at the rear which we declined to inhabit for reasons other than the dark and smoke. Here at Munigaon we saw the first indications of Buddhism, fluttering prayer flags, a rather inelegant chorten and a mani wall as well as a mani stone as big as a house with "Om mani padme hum" carved in huge Sanskrit characters upon it.

We were now within a day's march of Jumla. The grassy hillsides at 10,000 feet were becoming mauve with the flowers of *Primula denticulata* and in wet flushes *P. involucrata* was just opening its flowers which here were rich purple. As we approached Jumla the Peach blossom in the surrounding villages, seen against a background of snow-covered mountains, was a lovely sight. Women were coming down to these villages from the surrounding forests with immense loads of dry Pine needles which they had gathered on the hillsides above and which would be used as bedding material for their cattle. We reached Jumla in the early evening and here we were met by a crowd hundreds strong which had turned up to see us arrive. We were conducted to a house which the Governor of Jumla very kindly put at our disposal, but tired as we were we had to wait patiently while tools were found to wrench off the massive lock, for the key appeared to have been mislaid at the last minute. Jumla, which is the centre of government for the province

of that name, is situated in the valley of the Tila river at an altitude of about 7,600 feet. The surrounding hillsides, particularly those with a northerly aspect, are forested with *Pinus Chylla* with here and there remnants of *Cedrus Deodara*. This latter tree we found growing in pure stands as a forest tree in side valleys and also farther east near Tibrikot, a considerable eastwards extension of its known range. The summer crop is Rice and the winter crop of Barley was just coming into ear when we arrived.

The first few days after our arrival were occupied in preparations for the next stage, particularly in making the arrangements necessary for working as three independent parties. Visits were exchanged with the Governor, Shri Bahadur, who did all he could to help us. The Indian bank-notes which we had brought with us had to be changed into coin, for paper money was not acceptable; neither, strangely enough, were Nepali rupees and stacks of Indian rupees had to be counted and tied into bags. Another unexpected task which came our way was the repair of the motor driving the generator for the Jumla wireless transmitter. Without wireless communication administrative work was extremely difficult, for letters from Katmandu, the capital, took more than a month to reach Jumla. Yet, although in this remote province use was being made of wireless, it was the only innovation from civilization; for instance, nowhere were there medical services in any form and wherever we went we were called upon to treat and prescribe for sufferers from a wide range of diseases and injuries.

As we had expected we were a little too early for plants in the alpine zone but our expedition was botanical as well as horticultural and all plants, ferns, mosses, lichens, fungi and flowering plants, hardy or not, were grist for our presses. Spring had been unusually late, only two weeks before our arrival there had been two feet of snow in Jumla and above 10,000 feet snow was still lying deeply. To test the working of our three parties and to employ profitably the time while the snow melted and the first alpines appeared we went down to the Karnali valley for a journey taking less than three weeks. The Karnali, which rises in Tibet near the Manasarowar lake, cuts right through the main Himalayan range flowing in a deep gorge-like valley. Here, where the river flows at less than 4,000 feet, the ridges on either side rise steeply to about 14,000 feet, each party worked a separate area. The valley itself was very hot and traversing the sides with a slope of over 45 degrees with the temperature over 95 degrees was fatiguing work. Before midday a strong up-valley wind would develop and in the late afternoon a thunderstorm was the rule and it was only with difficulty that the tents could be kept standing in the light soil. Except for occasional patches of subtropical forest and thickets of Palms, the vegetation was often xerophytic. Whole hillsides were covered in tree Euphorbia, *Euphorbia Roylei*, a gaunt and spiny succulent species. Cultivated areas were hedged with *Opuntia* and *Agave*, the former with bright yellow flowers while the inflorescences of the latter had already reached a height

of 15 feet. Cliffs were draped with 12-foot-long curtains of a fleshy, leafless Asclepiad, a species of *Sarcostemma*. The turbid, swirling grey waters of the Karnali were crossed by a different method by each party. One was hauled across in a cradle type of rope bridge, another crossed by a large dug-out boat, while the third used a swaying rope bridge with a flimsy, slatted footway. It would be hard to judge which was the most precarious. The great difference in climate brought about by a difference in altitude was particularly evident here in the Karnali valley for the harvesting and threshing of Barley was in full swing while at Jumla the crop was only just coming into ear.

We returned to Jumla early in May and on the eleventh of the month set off on the main journeys of the expedition. Since SYKES's responsibility was mainly horticultural it was arranged that the area which he would work should be that likely to yield the best harvest of potential garden plants. We guessed that this might be in the vicinity of the western end of the Dhaulagiri Himal and in this selection we later found that we were not mistaken. POLUNIN was to travel with SYKES as far as the Dhaulagiri Himal, carry on eastwards along the northern flank of this massif and then double back north-westwards along a high valley lying between the main Himalayan range and the so-called Ladakh range. I was to travel northwards to Simikot and the district of Humla and if possible to explore the Mugu Khola. Towards the end of our journeys it was hoped that POLUNIN and I would be able to link up and return to Jumla about July 30 where we would once again meet SYKES.

These carefully laid plans had to be considerably modified. Only two days after leaving Jumla SYKES went down with jaundice. This necessitated a fortnight's halt while he recovered but fortunately POLUNIN was with him and he and the collectors were able to carry on plant hunting as well as to care for SYKES. When POLUNIN reached his area he found his planned route barred by swollen rivers which had swept away essential bridges and, a month later than SYKES, I too went down with jaundice. We all modified our plans to meet the altered situation and minimized the setbacks as far as possible.

On the hills around Sialgarhi where SYKES lay ill, *Meconopsis grandis* grew in abundance among *Rhododendron campanulatum*, with large clear blue petals and bright yellow stamens and on the more open hillsides *M. regia*, often 6 or 7 feet high, displayed its pale yellow slightly drooping flowers. As soon as SYKES was able to walk again he and POLUNIN carried on eastwards to Tibrikot. Here they parted and went their separate ways, SYKES up the Suli Gad to the Phoksumdo Tal and POLUNIN eastwards towards Chharkabhotgaon. In the vicinity of the Phoksumdo Tal, a lake whose wonderful blue-green waters were overshadowed by the 23,000-foot peak of Kanjiroba, SYKES found two undescribed species of Primula. One of these, a *Soldanelloid* growing on rock ledges bore a resemblance to *Primula Sandemanniana* with its drooping pale blue flowers while the other, which grew on exposed south-facing stony slopes, had pink flowers and unusual round leaves,

Photo, O. Polunin

FIG. 93—*Megacarpaea polyandra* growing in the lower alpine meadows; the flowering stems attain as much as 8 feet in height

Photo, L. H. J. Williams

FIG. 94—Tharu porters carrying boxes containing some of the expedition's botanical collections on the last stages of the return journey

Photo, O. Polunin

FIG. 95—The expedition's camp at Maina, south of Chakhure Lekh, at an altitude of 6,500 feet

FIG. 96—*Fritillaria cirrhosa* in the lower alpine meadows

Photos, O. Polunin

FIG. 97—*Stellera chamaejasme*, a common plant on the drier hillsides at between 8,000 and 11,000 feet

Photo, J. E. Downward

FIG. 98—(Left) Stoloniferous hybrid Nomocharis showing bulblets on juvenile growth, and (right) a flowering plant of 6 feet in height of *N. Mairei* from Keillour Castle, Perthshire

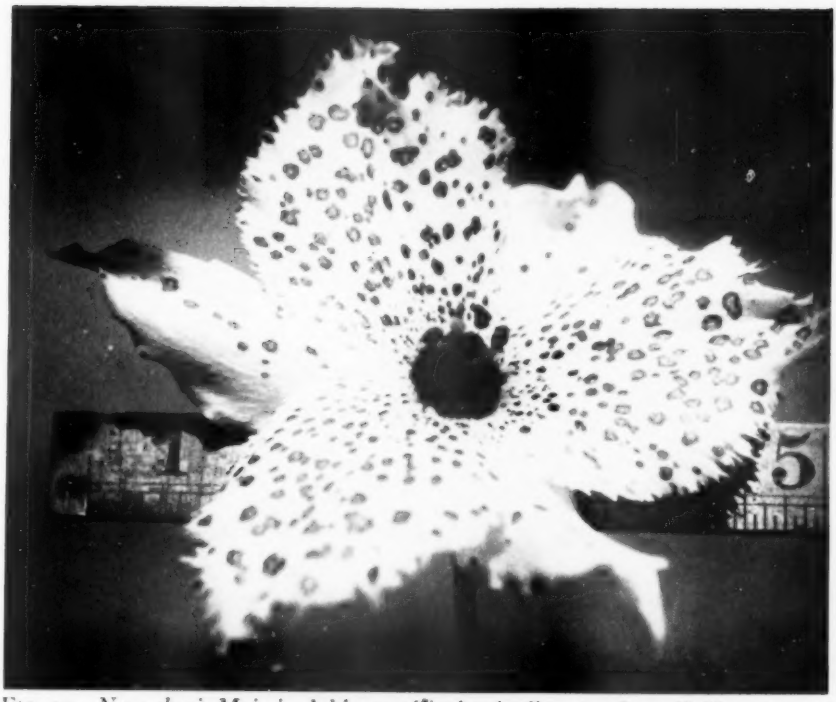


FIG. 99—*Nomocharis Mairei*. A bloom 5½ inches in diameter from Keillour Castle

Photos, W. G. Knox-Finlay

FIG. 100—A group of Nomocharis at Keillour Castle

Photo, J. E. Downward

FIG. 101—Begonia 'Clarissa Hutchinson' **F.C.C.** Chelsea Show, 1953, a variety with large rosy-salmon flowers raised and shown by Messrs. Blackmore & Langdon, Twerton Hill Nursery, Bath

Photo, J. E. Downward

FIG. 102—*Verbascum Pestallozae* **A.M.** Chelsea Show, 1953, a perennial dwarf Mullein with yellow flowers introduced in 1949 from seed collected by PETER DAVIS in Lycia, Anatolia, Turkey, and shown by MRS. C. B. SAUNDERS of Farnborough, Kent

Photo, W. F. Sedgwick Ltd.

FIG. 103—The Model Fruit Gardens at the R.H.S. Gardens, Wisley (See pp. 344-9)

farinose beneath, borne upon long petioles. Growing in some profusion on well-drained rocky banks was a species of *Incarvillea*, resembling *I. grandiflora*, its exotic-looking pink flowers seeming quite out of keeping with its rugged alpine habitat. Here too SYKES found an attractive Willow with large red catkins. All these he marked as desirable and worth collecting as living plants or as seed later in the season. From the lovely valleys and rocky slopes near the Phoksumdo Tal he went to Jangla on the north-western flank of the Dhaulagiri Himal. Here, at about 13,000 feet, he found a form of *Parochetus communis* with brilliant blue flowers of more than twice the usual size. *Anemone narcissiflora* which covered the slopes above the tree line had white flowers at lower altitudes while higher up the flowers were various shades of mauve and magenta. To enumerate and describe the many good plants which SYKES found would occupy more space than is available, for in the Phoksumdo Tal and Jangla areas he collected over 500 specimens.

POLUNIN'S route took him behind the rain screen formed by the Dhaulagiri Himal and provided a less rich flora. Hillsides were covered with stunted bushes of *Juniperus squamata*, *Caragana versicolor* and *Lonicera rupicola* while at higher altitudes the vegetation consisted of characteristic cushion and scree plants such as *Androsace tapete*, numerous Potentillas, dwarf Willows and species of *Saxifraga* and *Calophaca*. At Tarenaggaon POLUNIN turned north and reached the Tibetan border at the Marem Bhanjyang, a pass of over 19,000 feet on one of the Nepal-Tibet trade routes. Here he was in an area inhabited by Bhotias, a Tibetan-like race who live in the upper valleys of the central Himalayas. Some of their villages were built at very high altitudes and consisted of sturdy square stone houses with flat roofs and high walled enclosures for cattle and sheep. These walls and roofs were often piled high with firewood brought from the scanty forested areas lower down. Each village, with a population of a hundred or two people, had its groups of chortens, for these people are Buddhists. These chortens, decorated as they were in reddish brown and cream with stucco plaques of strange birds, beasts and religious symbols were an extremely attractive feature amid the barren landscape. Close by each village were small carefully cultivated and irrigated terraces but in mid June the young Corn was only about 6 inches high and they were obviously not able to grow enough to support themselves but relied upon trading and their considerable herds of yak, sheep and goats. The route westwards being impossible he travelled south-west over several passes exceeding 20,000 feet back to Tibrikot and then westwards again to the Chaudhabise area to the east of Jumla where he spent three weeks collecting intensively in the country near Maharigaon. Among the many lovely plants which he found here was a species of Primula closely allied to *P. Duthieana*, which grew along the margins of small mountain streams.

My own route northwards to Humla and Simikot took me around the lake of Rara Daha, the largest in Nepal, a 3-mile stretch of crystal-clear

water lying in a crater-like depression in the hills at an altitude of nearly 10,000 feet. The surrounding hillsides were clothed in forests of *Pinus Chylla* and thickets of *Juniperus indica* and, as well as open grazed slopes, a considerable area was used for the cultivation of Buckwheat. From Rara Daha the track descended steeply, dropping 4,000 feet in four miles to the Mugu Karnali valley. Here women were at work in the fields harvesting Barley by plucking the heads between two crossed bamboos. From the Mugu Karnali, which we crossed by a large cantilever bridge built of huge baulks of timber, the track rose once more to the 12,000 feet pass of Chankheli Lagna. Below the summit on the southern slope were forests of *Quercus semicarpifolia*, the floor of which was studded with delightful clumps of *P. Edgeworthii* with pale mauve-pink flowers and the bright yellow flowers of *Viola biflora*. Above the tree line the open meadows were sheeted with the blue and white flowered forms of *Anemone obtusiloba*, the blue a deep velvety colour which the plant never seems to attain in cultivation. Here too were drifts of short-stemmed *Iris kamaonensis* with flowers of a variety of shades of mottled blue and purple. *Fritillaria cirrhosa* was already fully open with its chequered dull brownish purple nodding flowers (Fig. 96) and the yellow stars of *Gagea lutea* which had not previously been found in Nepal, were beginning to appear. In the deciduous forest on the northern flank of the pass were small trees of *Viburnum cordifolium* with flowers of a brilliant whiteness, *Rhododendron barbatum* and many colour forms of *R. campanulatum*. Growing in the shade of bushes of *Syringa Emodi* in wet ground were plants of *Meconopsis napaulensis* with nodding flowers of a bright brick-red. Once more the track dropped through Oak and Bamboo forest with *Piptanthus nepalensis* in open places, a mass of yellow flowers, through tree Rhododendrons and Pine forest to cultivated terraces on the banks of the Tanke Khola, here flowing at little over 5,000 feet in another hot valley. On the next pass, among thickets of *R. campanulatum*, were drifts of *Primula denticulata* with magnificent spherical heads of bloom and another robust species, *P. strumosa*, with flowers of a bright buttercup-yellow. Drifts of snow were still lying on the summit and north flank of this 13,300-foot pass where the undergrowth of *Cassiope fastigiata* and *R. hypenanthum* looked cold and almost lifeless. On our return over this pass, the Margor Lagna, we found *Lilium oxypetalum*, hitherto only known to extend as far east as Kumaon.

A week was spent in the Dozam Khola, a valley just to the east of Simikot, which leads up from the Humla Karnali to the Tibetan border. Our first camp, near the village of Dozam at about 8,000 feet, was pitched among thickets of Walnut trees. The people here were Buddhists and the men wore their hair in a curious narrow top-knot about 5 inches high. Besides twelve coolies from the village we had with us the local shikari with his two leashed dogs and a very ancient muzzle-loading gun, the report of which must have scared all the bears and leopards for miles up the valley. Above Dozam, the valley is uninhabited

except for the few hovels of those cultivating Buckwheat and the shelters for shepherds on the high pastures. Just above the village there was a dense growth of shrubs, *Deutzia staminea* covered in fragrant white flowers and several species of Berberis and Cotoneaster over all of which twined the vigorous growth of *Rosa moschata*, a fragrant white flowered species, while the even more strongly scented flowers of *Jasminum officinale* hung down in profusion. Much of the valley was steep-sided and boulder-strewn but where it widened there first came deciduous woodland, forest of Spruce and Silver Fir, then *Betula utilis* with an undergrowth of *R. campanulatum*, and above the open slopes with *Juniperus* and *Lonicera* scrub. Two days up the valley our loads were transferred from the coolies to yaks, shaggy, clumsy-looking, seemingly slow beasts which in reality were remarkably sure-footed and covered the ground at an amazing pace. In the Birch and Rhododendron zone the delicate flowers of *Podophyllum Emodi* in many shades of pink were just opening as were the hardy steel blue-coloured flowers of *Meconopsis discigera* which grew among boulders. What must surely be the largest of the *Cruciferae* grew here, *Megacarpaea polyandra*, an enormous plant, often 8 feet high with uninteresting cream-coloured flowers borne upon a stem 3 inches in diameter (Fig. 93). In open grassland with *Iris kamaonensis*, grew *Adonis chrysocyathus* with finely divided leaves and bright yellow flowers nearly 1½ inch in diameter, and on well-drained stone slides were hosts of *Anemone rupicola* with delicate white flowers. There was a wild Rhubarb growing here which the hardy hill people had no hesitation in eating raw but Western stomachs are not attuned to such feats. We penetrated this valley as far as Kharchyun, a summer grazing camp about 8 miles south of the Tibetan border, but although it was now late May, few plants were yet in flower and at our highest camp at between 14,000 and 15,000 feet it was snowing hard. On the return journey down the valley we had almost continuous cold rain and the high valley walls were hidden in cloud.

It was our intention to visit Simikot, a village which is the centre of government for the Humla district, and then to explore the country on either side of the Humla Karnali river up as far as the Tibetan border. Soon after leaving Simikot an attack of jaundice, which I did not diagnose as such at the time, together with the comparative dryness of the hillsides and vague reports that SYKES was very ill necessitated the abandonment of these plans. As another load in a basket carried by four coolies I was jolted back to Jumla to convalesce and find pastures new. It was not until I was well on my way south that I received definite news that SYKES had been down with jaundice a month earlier and I knew that in all probability he was now well again. The effects of my own attack had abated soon after I reached Jumla and I spent a week collecting in the vicinity while I regained strength. On the rather dry hillsides, *Stellera chamaejasme* grew in abundance with its sweetly scented white flowers the tubes of which were bright orange-red (Fig. 97). *Lilium nepalense* with nodding yellowish flowers and *Notholirion macrophyllum* with

pink Lily-like flowers were common everywhere. Both are of doubtful hardiness in Britain but here on their native hills with very sharp drainage, they endure frost, snow and drying sunshine in winter while in summer they are subjected to heavy rainfall. On many of the flat beaten earth roofs of the village houses there grew a row of Marigolds and Tobacco plants, the former for use in the Hindu temples and for festival decorations and the latter to provide next season's seed for the small gardens where, besides Tobacco, Maize, Potatoes, Chillies, Aubergines, Marrows and Cucumbers were grown. SYKES had brought a supply of vegetable seeds from England which had been sown in the Governor's garden soon after our arrival and these provided us with a welcome supply of salads and fresh greens for the brief periods when we were in Jumla.

Our next objective was the ridges to the south of Jumla which stretch from the Dhaulagiri Himal in the east right to the Karnali river in the west, a distance of about 150 miles broken only in one place by the Bheri river. It is a biological and climatic barrier of some significance and although in the vicinity of Jumla it does not exceed 16,000 feet in height the country to the north is noticeably drier than that to the south. POLUNIN noted that several species of birds failed to cross it. The open hillsides were a vast grazing ground for flocks of sheep and ponies tended by shepherds who spent the short alpine growing season in rough shelters of bent bamboo covered with goat wool rugs and sheets of the bark of the Himalayan Birch. The lower alpine meadows were a sea of flowers; Potentillas of every shade between bright red and yellow, deep blue and white forms of *Anemone obtusiloba*, the purple of *Geranium Lambertii* and the soft pink of *Polygonum sphaerostachyum* to mention but a few. On rock ledges which dry out completely except during the monsoon were groups of *Primula Reidii* with nodding, delightfully fragrant white flowers and hairy leaves which held sparkling drops of water. The higher meadows although less colourful held their treasures, the creamy white flowers of *P. Buryana*, *P. macrophylla* var. *Moorcroftiana* with white-eyed pink or purple flowers, *Lloydia longiscapa* with darkly veined white perianth lobes with orange bases and *Polygonum affine* with flowers of an intense red which this plant never even approaches when grown here in Britain. The richness of the flora of these ridges may be judged from the fact that here during July we collected nearly 600 specimens in little over three weeks. Besides collecting we were kept hard at work in camp writing field notes and changing the paper in our numerous presses. This press paper we dried round a big log fire and during our stay in Nepal we must have burned many tons of wood for this purpose.

At the end of July we all met once again in Jumla, for POLUNIN had to return to England on the expiration of his leave. In addition to having had jaundice SYKES had been suffering considerably from the effects of dysentery from soon after our entry into Nepal and during July he had become so ill and weak that he had to be carried. His condition

was such that, much as he wished to stay and I regretted losing him, it would have been dangerous for him to remain and it was decided that he should return with POLUNIN, leaving his collectors with me to assist with the collection of seeds and living plants. After a few days at Jumla going through our collections and making preparations for the return journey, they left Jumla on August 10 and after a hot and rather difficult journey through monsoon weather at lower altitudes, arrived back in India early in September.

Two days before their departure I returned once more northwards, this time to the valley of the Mugu Karnali. This valley, which terminates on the Tibetan border at the Namja La, a pass of 16,200 feet, is an important trade route between Nepal and Tibet, Rice and Barley flour from Nepal being exchanged for Tibetan wool and salt. Where I entered the valley the river flows at 6,400 feet and from there the ascent was gradual. The slopes of Chir Pine, *Pinus Roxburghii*, gave way at 8,000 to 9,000 feet to *Cupressus torulosa*, a splendid tree often over 150 feet in height. Around the village of Mugu with its numerous chortens, I lost count of them in the forties, the fields were bright with pink-flowered Buckwheat, and Wheat was still unripe here at 12,000 feet. Two rather attractive weeds were *Nepeta Leucophylla* and a Balsam with large yellow flowers. The valley itself was comparatively dry although the monsoon was still at its height and although the mountains on either side were hidden by dense white cloud there was usually a ribbon of blue sky following so exactly the windings of the valley that a change in direction of the river could be seen in the sky long before it actually came into sight. Above Mugu, in the Birch zone, meadows were pink with *Impatiens glandulifera*, the Balsam which has naturalized itself so successfully here in Britain. At 15,000 feet *Gentiana venusta* and *G. algida* forma *Przewalskii* were both in flower and here too grew *Delphinium Brunonianum* with large translucent pale blue flowers. On the pass itself were the densely woolly inflorescences of *Saussurea leucoma*, the pale pink-flowered cushions of *Arenaria glanduligera*, which with *Allardia glabra* crouched in the shelter of boulders, and several species of *Corydalis* and *Cremanthodium*. The view northwards into Tibet was one of brown arid rolling hills, parched by sunshine beating down from a cloudless sky while to the south the billowing clouds and rain squalls of the monsoon were barred from entry into Tibet by the immense wall of mountains.

Little time could be spared in the Mugu Khola for the area where SYKES had worked earlier in the season, and where we were to make our main collections of seeds and living plants, lay some 70 miles to the south. My return southwards was somewhat hampered by bridges which had been swept away and landslips had taken whole stretches of the path down to the turbulent river below, eventually to join the Ganges and add to the silt upon the plains of India. It was now late August, the passes I crossed had lost their wealth of flowers and the meadows were looking bedraggled and weather-beaten, only a few late-flowering

species remained, the tall yellow inflorescences of *Cremanthodium*, a mauve *Erigeron* and the rich blue-purple flowers of *Cyananthus lobatus*.

Taking a different route to Tibrikot I went down to lower altitudes where Maize was ripening and where the people had erected small shelters among the fields in which they spent the night to scare off marauding bears which dearly love to make a meal of the Maize cobs. From these little shelters, often raised on stilts, cords to which bells were attached radiated in all directions supported on flimsy bamboos. By occasionally jerking the end of the cord in the hut the bells would clatter often several hundred yards away. It was very reminiscent of the overhead wire system to the cashier's desk once used in large departmental stores.

In early September I collected my first living plant, *Cypripedium cordigerum*, a white-flowered species with a yellow lip. The roots were wrapped in a little slightly damp moss and packed in a polythene film bag. Although it did not reach Wisley until early in November after travelling through Nepal and the heat of the plains of India, the polythene film kept it sufficiently moist and it is now growing vigorously. This *Cypripedium* was growing on the shrub-covered slopes of Deoli Patan where the scarlet hips of *Rosa macrophylla*, fully 2 inches long, were very conspicuous. Here, too, grew a *Euonymus* with brilliant orange-red fruit hanging from the open, red-flushed capsules. On the summit of the pass over this ridge *Gaultheria trichophylla* formed prostrate dark green mats with fruits which looked as if dozens of marbles of an unbelievable Forget-me-not blue had been strewn over them. The country around the Phoksumdo Tal was now dry and bathed in bright sunshine after the dull weather of the monsoon. The *Incarvillea* bore an abundance of ripe seed capsules and we were able to gather these as well as its thick taproots. Several species of *Cotoneaster* carried a rich crop of red berries which provided a striking contrast to the intense blue flowers of *Ceratostigma plumbaginoides* which grew among them. On some of the sunny south-facing slopes there were woodlands of wild Peach trees which in spring must have been a truly wonderful sight. Now, in mid-September, the ground beneath them was thick with their fallen fruit which, in strict moderation, was edible. NAT SINGH, one of the collectors, exceeded this limit and suffered very severely as a result. On peaty slopes at about 15,000 feet, prostrate plants of *Rhododendron Lowndesii* still had a few belated flowers but unfortunately no seed was ripe, for this species, which COLONEL LOWNDES collected for the first time in 1950, is a most desirable garden plant. The Buckwheat was now being harvested, and growing among it as a weed *Codonopsis convolvulacea* was still producing a few late flowers of a pleasant shade of blue. After much digging I was able to secure a gathering of its deep-growing tubers from the light gritty soil. In one field of Barley stubble which had been ploughed for the autumn sowing numerous bulbs of *Lilium nepalense* which had also been growing as a

weed were turned up and it was an easy matter to collect a bagful. To locate plants in the autumn which have previously been seen in flower can be extremely difficult, but I had not even seen them flowering. Nevertheless, with the help of SYKES's collector, I was able to find the two Primulas and the red catkin Willow as well as numerous other plants.

By way of the 18,500-foot pass of Kagmara Lagna I returned to Jumla for the last time where the final packing of the collections occupied several days. Some living plants were wrapped in moss and some in polythene bags and all were carefully packed in two bamboo baskets, each covered in white cotton cloth to help conserve the moisture and minimize the effect of the hot sun at lower altitudes. These baskets, each a coolie load, contained 86 gatherings, amounting to some 250 plants. The seed collection, which had inevitably suffered owing to the unfortunate loss of SYKES, consisted of 150 gatherings. The herbarium material amounted to over 5,000 specimens, the largest fully documented collection to have been made in Nepal, the naming of which at the British Museum Herbarium will take a considerable time.

The return journey began on October 8, back once more over Chakhure Lekh, snow-covered when we arrived, a blaze of flowers in June and July and now brown and autumnal with fresh snow already lying in sheltered places. Down once more to the warm valleys where the Rice harvest was in full swing and to the Indian border which we reached on the last day of the month. The living plants were sent off to England by air as soon as we arrived in Bombay. On the whole, they survived the journey remarkably well. One of the new Primulas has already flowered and has been exhibited at Vincent Square but whether it and the many other plants and seeds will prove amenable to cultivation remains to be seen.

In conclusion, on behalf of myself and my two companions, I must express a deep debt of gratitude to all who made it possible for us to take part in this most memorable journey and in particular to the Council of The Royal Horticultural Society and to DR. GEORGE TAYLOR, Keeper of Botany at the British Museum (Natural History).

CULTIVATION OF NOMOCHARIS AT KEILLOUR

W. G. Knox Finlay

(*Lecture given on July* 7, 1953; COL. F. C. STERN, O.B.E., M.C., F.L.S., V.M.H. *in the Chair*)

I FIND that the cultivation of Nomocharis is fairly easy if I am content to grow them at an average height of say 15 inches. To get them larger I have to take more care to create the right conditions for fuller development. As they hang their heads it is a great advantage to have them tall so that the flowers can be better seen. My best Nomocharis at present are about 5 feet in height. I have a specimen here which is perhaps a little better than our average for fully matured bulbs; it was lifted from the open at the side of a group. The height is 6 feet; there were sixteen flowers, the largest of which measured $5\frac{3}{4}$ inches in diameter. The species is *N. Mairei*, but other species grow equally well (Fig. 98, right).

I have been asked to come here to-day to tell you how I grow tall well-flowered Nomocharis. After ten years of trial and error I am convinced that the answer to the problem is patience, combined with a study of the conditions required, the main factors of which are as follows: an open situation with no ground cover (any I have planted in the shade are weak); water underneath in quantity at a favourable depth, a free root-run and quick drainage. We have sown seed indoors in boxes, pricked them off, potted and plunged them and have tried numerous mixtures for our experiments. We have also for years broadcast seeds in open shaded frames. There is no doubt in my mind that the sowing of seed in the open and leaving the young bulbs undisturbed produces the best results. A hurried bulb does not produce a first-class plant; it may look well but lacks in stamina. My method of producing good flowering bulbs may take five years or even six but it is worth while, and thereafter I always have a young crop coming on.

If you feel you cannot wait for bulbs grown from seed in the open, my advice is to sow the seed in boxes in a cool or cold house, prick them out as soon as possible and winter them in a cold frame. They must be lined out in an open frame early in the following spring and planted out at the flowering stage. As I have said I do not advise this method but it does in some way combine with getting the bulbs into the open as soon as possible and so not forcing them. Nomocharis also grow away quickly from scales, thus saving a year or more, but one can only take one or two scales from each bulb, and it is not easy to do this without messing up and disturbing a group of established bulbs.

Scales are taken when the bulbs are dormant. With bottom heat they begin to form bulblets almost immediately, and very soon roots

and top growth. In six weeks' time some of the bulblets are ready to move and nearly all in eight weeks. Most scales form more than one bulblet; these are separated with a razor blade leaving as much as possible of the scale attached. After they have been potted up individually and gradually hardened off, they should be plunged in the open frames. They should be ready to plant out as flowering bulbs in three or four years' time.

My stock of Nomocharis has been raised from bulbs I saw advertised in 1942. When I was home on leave, I planted them out and left them alone. It was a lucky planting, quickly done with no special knowledge of their requirements except common sense. Nearly all our present flowering Nomocharis have been raised from seeds of these plantings. If I had read as much as I have now about this genus and tried to imitate the natural habitat as described by the various collectors, I am sure I would have done less well, because they appear to have been found growing in hundreds of situations from lush meadows to clumps of Bamboo, which must be the strangest of places to find a soft bulb growing.

I have studied herbarium specimens with special attention to the root retractile question and I think that the bulbs only grow down into soil to a sufficient depth to support the height of their stems. FARRER wrote that the depth of the bulbs he found "were as deep as the plants were tall" but did not mention the height of the plants. KINGDON-WARD writes that he found *N. pardanthina* 6 to 8 feet tall, but made no mention of the bulb depth. I can only think that these deep bulbs must have been buried by a landslide or were growing in very slack conditions, perhaps covered by encroaching vegetation. The dried specimens which I saw at the British Museum (Natural History) and the Royal Botanic Garden, Edinburgh, appeared to have been growing at a depth of only 2 to 3 inches. At Keillour the bulbs planted out have not gone down after six years of growth, and an annual autumn mulch seems to have made no difference.

So far I have found no proof of natural vegetative increase of the bulbs, but this is difficult to check as my plantings are done in groups. A damaged bulb will, however, increase from the scales. All the examples of herbarium material which I have seen show only single bulbs as do any old bulbs which I have lifted or grown on in pots individually.

I have some material here from a small colony of Nomocharis also grown from seed. This differs greatly in all characters from anything else we have raised. You can see that the stems are "stoloniferous" or "stoloniform" as some writers use that term when referring to the Asiatic Lilies. On the side of these stems, bulblets are formed which evidently eventually detach themselves to become separate units forming a colony (Fig. 98, left). From all appearances this only happens on the juvenile stem; seemingly, once the stem has discarded its one or two bulblets, it changes its habit and grows straight up from the bulb showing no further sign of wandering or forming bulblets. It is interesting

to see that there is no stem-rooting on the immature stems; this is only to be seen on the stem of a fully fledged plant. It will also be seen that this Nomocharis is not so strong in growth as the other species and when fully developed has brown stems and dark green rounded shiny leaves. It flowers from the juvenile growth sometimes only 2 inches high, the flowers of course being very much smaller than on older stems. The flowers all come true to type, being quite distinct from any others we have; they face much more outwards than downwards, are of a deep rose pink, with a small scattering of purple or crimson spots near the centre. Owing to the strong resemblance of the habits of the plants, I have been toying with the idea that we have a hybrid cross with *Lilium Wardii*, but the experts will not agree to this.

Regarding stem-rooting, this seems to be rather spasmodic. It is only present on some of the stems of the herbarium specimens I examined, and I could find no sign of bulblets having been formed on this growth which is so common with many Lilies. The same applies at Keillour; I have never found a bulblet on a stem-rooting plant and frequently no stem-rooting is to be seen.

It is said that we grow Nomocharis well because our atmosphere behind the tartan curtain is more humid. With this I do not agree. If it were so, many more gardens would have them. In my opinion you might as well say that we feed them on whisky. Our normal rainfall should be approximately 35 inches. From May 1952 to May 1953 we have only had approximately 15 inches with dry, cold icy winds and then hot weather. There has been much less humidity with us than there has been in the South according to the weather reports, and yet this year we have perhaps flowered our finest Nomocharis. Further, the young bulbs are in first class condition, so there is no use thinking that previous humidity may have done the trick.

I have been making tests regarding the depth of the water table at various places in my garden; I have also been digging holes and then checking the time of drainage during dry weather. I find that my best bulbs grow with a water table 3 feet deep and a drainage speed of 8 minutes. I have found this spring that top watering has been detrimental; a test I made proved that the unwatered bed is considerably the better bed. I have a bed near a pond which is not so happy. Yet one well-known gardener has written "give them adequate moisture." Just what does he mean by "adequate" or "give"?

The trouble about growing Nomocharis from seed is that they hybridize so readily. To keep them true, one would have to go to a lot of trouble hand pollinating and covering. I don't do this. As far as I can, I select by marking but I can give you no guarantee that those I name as I show you my slides, have no hybrid blood in them. If you wish a bed of one type, you must mark them when they flower in the seed-beds and plant out accordingly. I have never seen two identical plants. If you have studied the individual flowers on one stem of *N. Mairei*, *pardanthina*, *Farreri* or *aperta* as I have, you will have

found that each flower shows a difference in the number and position of the spots.

Some years ago we were told by an eminent gardener that if we allowed our plants to set seed we would very much impoverish them; in fact, lose them. We have seeded regularly with no ill effects, but it is probably wise not to let the young set seed.

My seed beds in the open are simply constructed wooden frames 6 inches high, filled with leafmould or old sawdust and sand over underlying forked over clay. The position is shaded by Conifers. The beds are firmed, the seeds are thinly broadcast, then lightly raked over and left for five years. When it comes to planting out time, I prepare by digging out beds to a depth of 18 inches in an area about 3 feet by 4 feet for thirty bulbs. I put as a foundation 8 inches of old compost made on the principle of the Indore system and pack it down very hard. Then I add 6 inches of what I call S.S.B., which means a mixture made up of a barrow load of old rotten sawdust (which is really humus with a *p*H of 6·3), a bucketful of sand, and a 4-inch pot of bone meal. The bulbs are placed on the top of this mixture, and another inch or so added to cover them; the soil from the excavation is used to fill up the beds and they are then well firmed down. The beds are then marked off, being surrounded by low rabbit netting. Even a well-netted garden may not be rabbit proof, and the young growth of Nomocharis seems to be most seductive. Other pests to be dealt with are slugs and mice, for the latter climb up the stems to eat the seed pods. I have read that they also eat the bulbs, but I have never experienced this trouble.

The late MR. ANDREW HARLEY of Devonhall was very successful in the cultivation of Nomocharis. I saw them growing in his garden about 1935 and was charmed with them. Many of you must have known his garden. Part of it is a semi-peat bog with, I am sure, a high water table all over. Now there are few flowering bulbs worth looking at. I was allowed to dig up a few to examine them recently; they appeared to be in poor condition, brown and with poor roots. Is it that this genus is short lived, or that the water table is too high at Devonhall? I think that the latter is the answer, coupled with starvation.

Before showing you my slides, I would like to say that I appreciate very much all the help I have had from my wife, and express my thanks to SIR WILLIAM WRIGHT SMITH for his assistance in giving me access to the Herbarium at Edinburgh, and also to DR. GEORGE TAYLOR for the same facilities at the British Museum (Natural History).

A NEW HYBRID EUCRYPHIA

A. J. Ivens, F.L.S.

IN Messrs. Hillier and Sons' woodland nursery at Chandlersford there is a Eucryphia of sufficiently unusual appearance to attract the attention of visitors with a keen eye for a new plant. It originated as a self-sown seedling, and, since being transferred to its present position in 1947, it has made growth which foreshadows a tree-like habit, withstanding every winter unharmed without protection other than that given by adjacent evergreens.

The original plant is now 7 to 8 feet high, and shows such unmistakable affinity to *E. lucida* Druce, and *E. Moorei* F. von Mueller that the probability of its having originated from a cross between these two species is overwhelming. Some of its leaves are trifoliate, but the majority are pinnate, with five or even seven or nine leaflets, of which the terminal one is about twice the length of the lateral ones. The leaflets are oblong-elliptic, rounded at the apex, shortly mucronate and glaucous beneath: an average 5-foliolate leaf has the terminal leaflet about 4·7 cm. long by 1·2 cm. wide, the sub-terminal pair 2·7 cm. by 1 cm., and the basal pair 2 cm. by 1 cm. As in the case of both parents the leaf-margins are entire and downy. The solitary flowers are beautifully formed, cup-shaped, and about 2·5 cm. across.

A hybrid having such aristocratic parents seems worthy of a Latin name, and as it seems fitting that this should commemorate its finder, MR. H. G. HILLIER, who was instrumental in ensuring its preservation, it is proposed to call it *E.* × *Hillieri* (*lucida* × *Moorei*) to which must be added a cultivar name to designate this particular form, the cross and its clonal descendants in conformity with the recently published Code. For this 'Winton' has been chosen. The full name of the plant is therefore *E.* × *Hillieri* 'Winton'.

Eucryphia × **Hillieri** Ivens, **hybr. nova** (*E. lucida* Druce × *E. Moorei* F. von Mueller). Planta hybrida haec inter species orta; foliis inter parentes intermediis oblongis vel ellipticis apice rotundatis, breviter mucronatis, subter glabris, floribus albis 2·5 cm. latis. ex hort. Chandlersford of Messrs. Hillier and Sons.

As this hybrid has so far proved to be almost, if not quite as hardy as *E. nymansensis*, and has the merit of flowering when quite young, even as a small plant raised from a cutting, it may be regarded as an interesting addition to the few known late summer-flowering evergreens of large size, at least for the mildest districts. It is easily distinguished from the only hybrid of *E. lucida* hitherto recorded, *E.* × *intermedia*, which has simple or trifoliolate leaves with prominent serrations, by its pinnate leaves and entire leaflets.

Eucryphia Moorei *Eucryphia lucida*

Eucryphia × Hillieri

A New Hybrid Eucryphia ; a leaf comparison of the hybrid with its supposed parents.

THE DEVELOPMENT OF THE MODEL FRUIT GARDENS AT WISLEY

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IT is now six years since the Model Fruit Gardens were planted, and judging from the interest shown by visitors their existence has already been more than justified. An article in the 1947 *Fruit Year Book* dealt with their planning and planting, but for those who are not familiar with them one or two of the more interesting points are worth repeating.

The three gardens, large, medium and small, were planned primarily to give the amateur a practical example of how to make the best use of small areas for fruit growing. The layout varies with size, but as the plan shows, each garden has the same range of fruits except that in the small garden there is not space enough for the inclusion of stone fruits. In the two larger gardens, the stone fruits have been kept to the north side so that there is no possibility of their shading the rest of the garden. The use of various restricted forms of trained trees such as dwarf bush, dwarf pyramid and oblique cordon can be seen at a glance (Fig. 103).

The soil in this area is sandy and cannot be considered ideal for fruit growing. However, with suitable treatment the growth, quality of fruit and general performance of both top and soft fruits can be quite satisfactory. The humus content of the soil first had to be increased. This was done by incorporating manure prior to planting and afterwards by annual mulches of manure and hops under the trees and bushes. The main advantage of a mulch on this light soil is that if applied early in the spring before the soil has become dried out it will retain soil moisture and offset the ill effects of drought should one occur during the summer. In addition to this it acts as a feed and, provided it is put on thickly enough, it will smother weeds. A complete fertilizer has also been given, not necessarily annually but every two or three years according to the state of growth of the trees and bushes. The mixture used is a balanced one containing two parts nitrogen, one part phosphates and one part potash by bulk, and it is applied during the latter half of April at 4–5 ounces per square yard, mainly to Plums, Black Currants, Gooseberries and Raspberries. Potash deficiency, which is liable to occur on light soils, is remedied by an annual dressing of sulphate of potash at 1–2 ounces per square yard.

General cultivation of the gardens consists of regular hoeing during

spring and summer to keep down weeds and maintain a soil mulch, followed by shallow forking in the winter once pruning has been completed. With Black Currants in particular, the soil between the bushes is often found to contain a mass of fibrous roots and, rather than injure these, the surface of the soil is simply pricked over.

A normal spraying programme carried out annually has kept the trees and bushes clear of any serious pest or disease, though isolated instances inevitably do occur and are treated as soon as they are noticed. So far, Apples and most Pears have been remarkably free from scab, but one variety of Pear, 'Doyenné du Comice,' particularly the dwarf pyramids, has been badly affected by it. Other diseases that have given minor trouble are brown rot in Apples, Pears and Plums (due almost entirely to initial damage by birds and wasps) and leaf curl in Peaches. Until now the most damaging diseases have been die-back (*Botrytis cinerea*) and coral spot on Red Currants, troubles which are particularly associated with light soils where vigour is liable to deteriorate. In spite of the mulching and feeding several of the bushes originally planted have had to be replaced. Strangely enough, Gooseberries have been almost free from die-back.

Perhaps the most notable failure was the Raspberry 'Norfolk Giant,' a row of which was planted when the gardens were originally laid out. After two years however, the canes were attacked by some unusual disease and the row had to be destroyed. The soil was retrenched and a new clean stock of the same variety was planted in the following autumn. This seems to have become quite well established and cropped for the first time this summer.

The most troublesome pests to contend with have been birds and wasps, particularly the former. An adjacent wind-break serves its primary purpose well but unfortunately is an ideal bird sanctuary. By far the worst offenders are jays as they literally strip trees of Apples and Pears. Grey squirrels are almost as bad. Soft fruits can be netted, but this is not a practical proposition for Apples and Pears and short of regular patrols with a gun it is difficult to devise any form of protection for them.

A certain amount of trouble can always be expected from aphis but this has invariably been cleared up by spraying with HETP. Besides effecting a good control it has the distinct advantage, from the human point of view, of losing its poisonous property within 24 hours of application, so that anything sprayed with it can be eaten quite safely two days later. It was known that HETP caused damage on the yellow-fruited sulphur-shy varieties of Gooseberry but it has also been experienced here on other varieties, in some cases causing serious defoliation. It seems therefore, that further detailed tests are needed and that until results of these are known it would be safer to spray Gooseberries with something else.

With such a large number of varieties concentrated in a small area adequate cross pollination is assured as long as weather conditions are

favourable. The importance of this is borne out by the experience of 1951 when, in spite of a wealth of blossom, the percentage of fruit set was very low. That particular spring was notable for this trouble because the weather was dull with cold winds almost throughout the flowering period and seriously restricted the activity of bees and other pollinating insects.

Slight damage from spring frost has occurred but not so extensively as in the valley site of the National Fruit Trials which is 60 feet lower than the Model Fruit Gardens and has no air drainage. As the Model Fruit Gardens adjoin the meteorological station, temperature records are available for comparison with those taken in the National Fruit Trials. There is always a difference of at least 4° between temperatures at the two sites recorded on a post 4 feet above ground level. This indicates just how important free air drainage is on nights when radiation frosts occur. No damage may be expected to flowers or fruitlets until the air temperature drops to 28° F. or below, but it must be remembered that this air temperature is recorded in a screen and not on an exposed thermometer such as the one on the post, which is the type of recording instrument normally used by amateurs. The temperature registered on an exposed thermometer would be several degrees lower than that registered in the screen.

It is worth noting the suitability of certain rootstocks for a sandy soil. For Apples three stocks were chosen, Malling types II, VII and IX. At the present stage there is little to choose in vigour between the dwarf pyramids on II and on VII, but with increasing age the trees on II should prove the more vigorous. The Apple cordons in the large garden provide a remarkable example of the difference in vigour between trees on the dwarfing IX stock and the semi-dwarfing VII. Here there are two adjacent rows of cordons with the same eight varieties in each, all the same age. Those on VII are consistently larger than their counterparts on IX, in some cases being twice as big with apparently no adverse effect on earliness of cropping. It remains to be seen whether those on IX will have sufficient vigour to continue growing as well as cropping. The semi-dwarfing VII rootstock has so far proved to be the most satisfactory for Wisley conditions.

The dwarf pyramids, and the dwarf bushes on VII have fruited well but are not all making quite as much growth as they should. Perhaps the biggest contrast is between 'Cox's Orange Pippin' and 'Sunset.' The latter is usually recommended for planting where 'Cox' will not do, but here it is the 'Cox' which does better. Neither the dwarf pyramids nor the bush trees of 'Sunset' have made much progress, whilst the 'Coxes' undoubtedly have. 'St. Edmund's Pippin,' 'Orleans Reinette,' 'Egremont Russet' and 'Epicure' have all fruited equally well but 'Ribston Pippin' and 'King's Acre Pippin' have been rather less prolific. The latter variety on cordons has suffered severely from bitter pit though the varieties alongside it have remained unblemished. However, 'King's Acre Pippin' may be one of the

varieties that are only liable to this trouble when young, the bitter pit gradually diminishing, to disappear eventually when the trees are fully developed.

Generally speaking, the Pears have not cropped as well as the Apples but will no doubt improve as the trees mature. The dwarf pryamid Pears on Quince A have done excellently however, and have invariably cropped much better than the cordons of the same varieties which are on Quince A and C. The Pear's upright habit makes it ideal for the dwarf pyramid and much better suited to this form than most Apples. So far there is no noticeable difference between cordons on Quince A and on Quince C either in growth or cropping. Some varieties of Pear are incompatible with Quince and if they are to grow satisfactorily they must be worked on an intermediate stock, 'Buerré Hardy' for instance. An excellent example of this incompatibility is to be seen in the variety 'Doyenné d'Eté.' The dozen or so cordons of this variety have more or less stood still since the day they were planted and in early autumn show an unusual early bronzing of the foliage. It was found that the trees had not been double-worked, and they will have to be replaced by others which are now being propagated.

Probably the shapeliest trees in the gardens are the half-standard Plums. Myrobalan B seems to be the best rootstock for this light soil and the trees have not only made excellent growth but have also cropped well and regularly. 'Denniston's Superb,' 'Jefferson,' 'Victoria' and 'Early Laxton' cropped so heavily last year that the trees had to be propped in several places. 'Czar' has always cropped well but apparently at the expense of growth as it is the smallest tree. 'Kirke's Blue' was infected with bacterial canker soon after planting and the head of the tree had to be removed, but fortunately new growth was produced from the stem and a shapely new tree has since been developed. Apart from this one instance, no trouble has been experienced amongst the Plums from either silver leaf or bacterial canker.

The only other stone fruits included are two Morello Cherries which have fruited well each year, and one Peach, 'Peregrine.' This received a check through bacterial canker and Peach leaf curl and has not yet cropped, though a few fruits set on in the spring of this year. It is interesting to note that the yellow-fleshed variety 'Rochester,' planted on spare ground close by, has done remarkably well, yielding a good crop of fruit each year.

The bush fruits have cropped consistently well, with fair crops even in 1951 when pollinating conditions were bad. The crop weights can be seen from the table on p. 349.

Of the Black Currants, 'Blacksmith' and 'Boskoop Giant' are outstanding, 'Blacksmith' in particular producing a very fine sample of fruit. The bushes have been remarkably free from any serious pest or disease and the excellent growth made annually shows how the disadvantages of a light soil can be overcome by adequate manuring and mulching.

Among the Red Currants, the recently introduced American variety 'Red Lake' has been exceptional. Each year it has been a prolific bearer, with large berries borne on a particularly long strig. 'Laxton's No. 1' has also produced excellent crops but this variety has suffered more than the others from die-back and coral spot, though this should not necessarily be taken as an indication that it is particularly susceptible to disease. 'Rivers' Late Red' has been disappointing, making vigorous growth each year but cropping poorly. 'White Grape,' the one white variety included, has rivalled 'Red Lake' for cropping and the fruit itself is of fine quality and very pleasant flavour. From one 'White Grape' bush no less than 15 lbs. of fruit were gathered in 1952.

Gooseberries have also done well and a routine spray of washing soda applied in late May each year has kept the bushes clean and free from American Gooseberry mildew, while derris has been used to good effect against sawfly. The trouble experienced with HETP has been referred to earlier in this article. 'Howard's Lancer,' 'May Duke,' and 'Whinham's Industry' have cropped the most consistently and the more recent introduction 'Green Gem' has also done well.

Three varieties of Raspberry were planted and of these 'Malling Promise' has given by far the best results. The original row of 'Norfolk Giant' was a failure while the third variety, 'Newburgh,' is nothing like so vigorous and fruitful as 'Malling Promise.' It is interesting to record that although June and July 1952 were particularly hot and dry, the Raspberries were given no water whatever. Instead, an additional heavy mulch of spent hops was applied after a freshening shower in early June and the rows responded very well, for not only was a good crop produced but a good supply of strong canes as well. In its early years, 'Malling Promise' tends to produce masses of surplus suckers, often many feet away from the row, but if these are systematically removed their production seems to lessen after four or five years.

Strawberries are not grown in the Model Fruit Gardens because, unlike the other fruit, they are a short-term crop and therefore best included in the general rotation plan of the vegetable garden. Sweet Cherries are omitted as there is still no dwarfing rootstock for them and they take up too much room in the small garden.

It was originally intended to surround the Model Fruit Gardens with an angle-iron fence on which a selection of trained trees could be grown, but instead two parallel fences were erected in the adjacent field. Young trees of Apple, Pear, Plum, Peach, Nectarine, acid and sweet Cherry are being trained into fans, while the spaces between them are temporarily occupied by trained bushes of a selection of soft fruits. It will be several years yet before the fan-trained trees come into bearing, but meanwhile they serve as good examples of the initial training of a fan. It is hoped that in their development and maturity they will add to the interest undoubtedly aroused by the Model Fruit Gardens.

Model Fruit Gardens, Wisley
Soft Fruit Crop Weights

		NO. OF BUSHES	CROP WEIGHT (LB.) 1951	1952
Red Currants	'Laxton's No. 1'	10	76	60*
	'Red Lake'	3	32	30
White Currant	'White Grape'	3	31	33
Black Currants	'Boskoop Giant'	10	42	82
	'Blacksmith'	10	51	90
	'Hawking's Excelsior'	3	10	18
	'September Black'	7	24	35
Gooseberries	'May Duke'	3	11	12
	'Green Gem'	3	9	16
	'Lancashire Lad'	4	7	7
	'Whinham's Industry'	3	7	19
	'Leveller'	3	5	3
	'Lancer'	7	25	30
	'Whitesmith'	3	13	8
Raspberries	'Malling Promise'	60 ft. row	27	75
	'Newburgh'	30 ft. row	4	17

* From eight bushes.

NOTES FROM FELLOWS

Note on the Exeter Oak (*Quercus lucumbeana* Sweet)

THE presence of a large number of Oaks of probable hybrid origin in the south and east of Devon directed attention to their possible nature. In 1772 HOLWELL noted in the *Philosophical Transactions of the Royal Society* that "about seven years back Mr. Lucumbe of St. Thomas (a part of Exeter)—observed a seedling oak—that kept its leaves throughout the winter." This was grafted by LUCUMBE, who was a nurseryman, on to stocks of *Quercus cerris* L. (the Turkey Oak) and widely planted in the neighbourhood of Exeter and the south-west generally. The name *Q. lucumbeana* was given to this hybrid by SWEET in 1827. Various authorities, then and since, are agreed that LUCUMBE'S Oak was probably a cross between *Q. cerris* (the Turkey Oak) and *Q. suber* L. (the Cork Oak) as pollen parent. It is to be noted that all the trees sold by LUCUMBE himself were grafted and the original tree was cut down, presumably about 1825 (ELWES and HENRY, 1910). LUCUMBE'S partner and son-in-law, PINCE, whose name incidentally is still associated with Pince's Gardens, a public park in Exeter, made the point to LOUDON that grafted trees and those from seed borne on the "Exeter Oak" should be carefully distinguished.

It is interesting to note, therefore, when there is such a wide range of presumably hybrid Oaks, that there is some doubt as to what precisely is the habit of *Q. lucumbeana*. BEAN (1936) describes it as "a deciduous, or in some of its forms, almost evergreen tree—a handsome and stately oak producing fertile acorns in plenty."

There are, as mentioned above, a large number of Oaks in the immediate neighbourhood of Exeter which might fit into the general description of the Exeter Oak. They vary in habit, in cork formation, in being deciduous or evergreen, in leaf shape, in the size and shape of the acorns, and in the ornamentation of the cupule, from those characters typical of the Cork Oak to those of the Turkey Oak ; almost every possible intermediate condition can be observed. All the intergrades seem to be fertile at least to the extent that some, if only a few, acorns are normally produced, but the numbers vary greatly from tree to tree. Some specimens appear to have been grafted, though it is not now possible to identify the stock. Many of the trees are well grown, but only one specimen, so far as can be ascertained, shows what may well be true hybrid vigour. One of the points which was made in connection with the original Exeter Oak by HOLWELL (1772) was that it grew remarkably fast—"21 feet high and 20 inch in girth"—in six years, as regards the original tree and a graft six years old had grown to a height of 23 feet—"the shoots in general grow 4 to 5 feet every year." The one tree which from a study of the chromosomes appears to be an F1 hybrid, does show evidence of having grown very quickly. Evidence that many of the trees known as Exeter Oaks may well be F2 and F3 hybrids grown from acorns of an original cross is perhaps afforded by the fact that there is marked difference of opinion as to the habit of the tree and, incidentally, also to the nature of the timber of the Oak itself. In an early reference to the Exeter Oak, R. PINCE in 1824 wrote: "the wood of the Lucumbe Oak is remarkably hard and its grain is of very close texture, equal if not superior to the best heart of oak. But the main advantage that this tree has over the common English Oak is the comparative short time it takes in forming valuable timber." Other writers have questioned the timber value and have actually indicated that it was not great. ELWES (1910), however, thought it was of some value—a view recently supported by A. L. HOWARD (1944).

No attempt was made by Lucumbe, so far as can now be ascertained, to bring about the cross which resulted in the Exeter Oak acorn. In fact, it was one of "a parcel of acorns—of the iron or wainscot species." It seems probable, therefore, that at other times and places similar crosses may well have occurred and ELWES and HENRY list other species which they suggest may be *Q. lucumbeana*.

CALDWELL and WILKINSON (1953) have tried to throw some light on the nature of the hybrid specimens in Devon and have in the press a detailed account of their observations. They have established that all the specimens they have examined have a diploid chromosome number of 24. The conclusion to which they came is that there may be a few

specimens of *Q. lucumbeana* which are F1 hybrids and exhibit fairly constant taxonomic characters, but more probably the intermediate types which represent F2 and F3 segregates should not be given additional specific names since it is doubtful if they would breed true.

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REFERENCES

ELWES and HENRY (1910): *Trees of Great Britain and Ireland.*
BEAN, W. J. (1936): *Trees and Shrubs hardy in the British Isles.*
HOLWELL (1772): *Philoss. Trans.*
HOWARD (1944): *Nature, Lond.*
CALDWELL and WILKINSON (1953): *Trans. Devons. Ass.*
SWEET (1827): *Hort. Brit.*

WISLEY TRIALS, 1953

BEARDED IRISES

The Council of The Royal Horticultural Society has made the following awards to Bearded Irises, on the recommendation of the Joint Iris Committee of The Royal Horticultural Society and the British Iris Society, after trial at Wisley. The number in brackets after the description of the variety is that under which it was grown in the trial.

BLUE RHYTHM. (Raised and introduced by Mrs. A. Whiting, sent by H. J. Randall, Esq., C.B.E., Sandilands, Brooklyn Road, Woking, Surrey.) **F.C.C.** June 12, 1953.—Plant vigorous, rapid increase, glaucous green foliage 24–26 inches long. Flowering stems 42–48 inches high, erect, slightly zigzag, six–eight-flowered. Flowers close, well proportioned, large. Standards domed, $3\frac{1}{4} \times 2\frac{7}{16}$ inches, Wistaria Blue (H.C.C. 640/1) with shading of Wistaria Blue (H.C.C. 640). Falls flaring, $4 \times 2\frac{1}{2}$ inches, Veronica Violet (H.C.C. 639) heavily overlaid Aster Violet (H.C.C. 38/1), with a slight pinkish violet cast and at extreme base of petal light brown feathering. Style and crest Wistaria Blue (H.C.C. 640/1), beard white tipped orange. Flowering from June 2. (**A.M.** 1950.)

JANE PHILLIPS. (Raised by Dr. R. J. Graves, Concord, U.S.A., introduced by Mrs. Nesmith, Lowell, U.S.A., and sent by H. J. Randall, Esq., C.B.E.) **F.C.C.** June 12, 1953.—Described R.H.S. JOURNAL **77**, p. 140. Colour of standards Flax Blue (H.C.C. 642/1) with brown striations at the extreme base. Colour of falls Flax Blue (H.C.C. 642/1) very faintly shot with pale mauve. (**A.M.** 1951.)

SABLE. (Raised by Mr. P. Cook, introduced by the Award Iris Nurseries, sent by Messrs. Kelway & Son, Ltd., Langport, Somerset.) **F.C.C.** May 29, 1953.—Plant vigorous, fairly rapid increase, glaucous green foliage, 24 inches long. Flowering stems 32 inches high, erect, straight, six-flowered. Flowers close, well proportioned, stiff, large. Standards domed, $3 \times 2\frac{7}{8}$ inches, near Royal Purple (H.C.C. 834). Falls straight hanging, $3 \times 2\frac{3}{5}$ inches, a very rich velvety shade of Royal Purple deeper than the standards. Style violet blue with white midrib, crest as standards, beard blue-tipped yellow. Flowering from May 25, 1953. (**A.M.** 1950.)

BLACK FOREST. (Raised and introduced by Mr. F. X. Schreiner, St. Paul, U.S.A., sent by H. J. Randall, Esq., C.B.E.) **A.M.** June 4, 1953.—Plant vigorous, of fairly rapid increase, glaucous green foliage 18 inches long. Flowering stems 30 inches high, erect and straight, eight-flowered. Flowers close, well proportioned, stiff. Standards cupped and arching with tips slightly adpressed, $2\frac{3}{5} \times 2\frac{1}{5}$ inches, Aconite Violet (H.C.C. 937/2). Falls flaring, $3\frac{3}{10} \times 2\frac{1}{5}$ inches, Aconite Violet (H.C.C. 937) with black sheen. Style and crest purple, beard violet. Flowering from May 29, 1953. [58]

ELIZABETH. (Raised and sent by A. T. White, Esq., Aldbury, Oaklands Avenue, Oxhey, Herts.) **A.M.** June 4, 1953.—Plant vigorous, of fairly rapid increase, green foliage 24 inches long. Flowering stems 36–38 inches high, erect and straight, six-flowered. Flowers close, well proportioned, large. Standards cupped and arching, $3\frac{3}{10} \times 3$ inches, Mimosa Yellow (H.C.C. 602/1) slightly deeper at base with brown striations. Falls flaring, $4\frac{1}{5} \times 3\frac{1}{10}$ inches, Mimosa Yellow (H.C.C. 602/1) deepening at haft to Mimosa Yellow (H.C.C. 602) with brown striations. Style and crest yellow, beard orange. Flowering from May 28. [73]

HI TIME. (Raised by Mr. F. D. Hall, Wilmette, U.S.A., sent by H. J. Randall, Esq., C.B.E.) **A.M.** June 4, 1953.—Plant vigorous, of fairly rapid increase, yellowish green foliage, 18 inches long. Flowering stems 30 inches high, erect, straight, eight-flowered. Flowers fairly close, well proportioned, medium. Standards cupped and arching, $2\frac{2}{5} \times 2\frac{1}{5}$ inches, Maize Yellow (H.C.C. 607/3) changing to Maize Yellow (H.C.C. 607) at base with brown striations. Falls straight hanging with tips slightly reflexed, $3\frac{7}{10} \times 2\frac{1}{2}$ inches, Maize Yellow (H.C.C. 607/3) deepening at edges to Maize Yellow (H.C.C. 607/1) changing at haft to Lemon Yellow (H.C.C. 4/1) with brown striations. Style and crest creamy apricot; beard orange. Flowering from June 2. [50]

LADY MOHR. (Raised and introduced by Mr. Carl Salbach, sent by H. J. Randall, Esq., C.B.E.) **A.M.** May 29, 1953.—Plant vigorous, of fairly rapid increase, yellowish green foliage 24 inches long. Flowering stems 36 inches high, straight, seven-flowered, requiring support. Flowers fairly widely spaced, well proportioned, extra large. Standards arching and cupped with tips adpressed, $3\frac{1}{2} \times 3$ inches, white, faintly tinged all over with mauve with reddish brown striations at base. Falls incurving, $4\frac{1}{10} \times 2\frac{9}{10}$ inches, near Sulphur Yellow (H.C.C. 1/3) changing to buff yellow towards haft with many striations of reddish brown. Style buff yellow with grey midrib, crest buff yellow, beard grey tinged yellow. Flowering from May 27. [79]

MARY VERNON. (Raised by Mr. J. W. McKee, Worcester, U.S.A., sent by H. J. Randall, Esq., C.B.E.) **A.M.** May 29, 1953.—Plant vigorous, of fairly rapid increase, green foliage 28 inches long. Flowering stems 36–42 inches high, erect, eight-flowered. Flowers fairly wide apart, well proportioned, medium. Standards domed and slightly overlapping, $2\frac{4}{5} \times 2\frac{3}{5}$ inches, Chrome Yellow (H.C.C. 605/1) upper part tinged reddish mauve with reddish mauve striations at base. Falls slightly sigmoid, flaring, $3\frac{4}{5} \times 2\frac{2}{5}$ inches, Chrome Yellow (H.C.C. 605/2) heavily overlaid Oxblood Red (H.C.C. 00823) with yellow striations on haft. Style and crest buff yellow, beard deep golden yellow. Flowering from May 23. [60]

MASTER CHARLES. (Raised and introduced by Williamson, sent by H. J. Randall, Esq., C.B.E.) **A.M.** June 12, 1953.—Plant vigorous, rapid increase, yellowish green foliage 24 inches long. Flowering stems 36–42

inches high, erect and straight, eight-flowered. Flowers close, well proportioned, large. Standards domed with tips slightly adpressed, 3 × 2½ inches, Bishops Violet (H.C.C. 34), yellow at base with brown striations. Falls flaring, 4 1/10 × 2 3/10 inches, Royal Purple (H.C.C. 834), haft white with brown striations, midrib tinged blue. Style white with purple midrib, crest violet, beard bluey purple. Flowering from June 3. [93]

MATTIE GATES. (Raised and introduced by Messrs. Sass Bros., sent by H. J. Randall, Esq., C.B.E.) **A.M.** May 29, 1953.—Plant vigorous, of fairly rapid increase, green foliage 24 inches long. Flowering stems 36 inches high, erect and straight, five-flowered. Flowers close, well proportioned, medium. Standards arching and cupped with tips adpressed, 3 3/10 × 2 2/5th inches, Empire Yellow (H.C.C. 603). Falls incurved, 3 9/10 × 2 3/10 inches, wide margin of Empire Yellow (H.C.C. 603) surrounding a white centre. Style lemon yellow with white midrib, crest lemon yellow; beard bright yellow. Flowering from May 28, 1953. [80]

NEW SNOW. (Raised and introduced by Mr. O. W. Fay, Wilmette, U.S.A., sent by H. J. Randall, Esq., C.B.E.) **A.M.** May 29, 1953.—Plant vigorous, of fairly rapid increase, green foliage 28 inches long. Flowering stems 42–48 inches high, very erect, straight, six-flowered. Flowers close, well proportioned, large. Standards domed with tips slightly adpressed, 3¾ × 3 inches, white. Falls flaring, 4 × 3¼ inches, white with brownish yellow striations at haft. Style and crest white, beard bright golden yellow. Flowering from May 28. [77]

SARAH GOODLOE. (Raised by Mr. G. Douglas, introduced by Mrs. Nesmith, sent by H. J. Randall, Esq., C.B.E.) **A.M.** June 12, 1953.—Plant vigorous, rapid increase, glaucous yellowish green foliage 24 inches long. Flowering stems 36 inches high, erect and straight, seven-flowered. Flowers close, well proportioned, large. Standards domed, 3¼ × 2⅜ inches, a very pale shade of purple near Pansy Purple (H.C.C. 928/3) with striations of a darker purple, extreme base of petal yellow with similar striations. Falls flaring with tips drooping, 4½ × 2⅖ inches. A very deep purple near Purple Madder (H.C.C. 1028) with a black velvety sheen, base of petal yellow with brown striations at haft. Style yellow with brown midrib, crest brown, beard yellow. Flowering from June 8. [98]

SEAGULL. (Raised by Mrs. I. C. Smith, Staten Island, U.S.A., introduced by Mr. K. W. Smith and sent by H. J. Randall, Esq., C.B.E.) **A.M.** May 29, 1953.—Plant vigorous, of fairly rapid increase, slightly yellowish green foliage 24 inches long. Flowering stems 36–42 inches high, erect and straight, eight-flowered. Flowers close, well proportioned, medium. Standards cupped and arching, 2⅘ × 2 7/10 inches, white with faint bluish tinge particularly on the lower half of the petal. Falls flaring, 3⅜ × 2½ inches, white tinged blue with yellowy brown markings at haft. Style and crest white, beard white-tipped golden orange. Flowering from May 26. [68]

ZANTHA. (Raised and introduced by Mr. O. W. Fay, sent by H. J. Randall, Esq., C.B.E.) **A.M.** June 4, 1953.—Plant vigorous, of fairly rapid increase, green foliage 24–28 inches long. Flower stems 36–42 inches high, erect and straight, six-flowered. Flowers close, well proportioned, very large. Standards domed with tips slightly adpressed, Aureolin (H.C.C. between 3/1 and 3/2) deepening to Aureolin (H.C.C. 3/1) at base. Falls flaring, 4⅘ × 3 1/10 inches, Aureolin (H.C.C. 3/1) changing to Lemon Yellow (H.C.C. between 4 and 4/1) at base. Style and crest yellow, beard orange. Flowering from June 1. [130]

BOOK NOTES

"Fritillaries." By Christabel Beck. Illus. 96 pp. (Faber & Faber Ltd.) 30*s*.

Many of us have been looking forward to this book on Fritillaries. There is no book which is devoted to the whole of this fascinating genus. Miss Dorothy Beetle published a monograph on the North American species but there is no book which covers all the cultivated species of Europe, Asia and North America. Miss Beck's book will be valuable to all horticulturists, as she describes the species from the gardener's point of view. The book begins with the early history of the genus, notes on the structure of the plant, and continues with their propagation and cultivation, and a descriptive list of the species. No one knows the cultivation and propagation of the species better than Miss Beck, so her experiences are valuable to gardeners. It is always good when those who are particularly interested in any class of flower, record their experiences in growing them.

There are no Fritillaria species with flamboyant flowers. *Fritillaria imperialis*, the Crown Imperials, are the most colourful but they all have charming attractive flowers. They are easy to grow. They look fine in the herbaceous border with their red or yellow bells and later they decorate the border with their crown of seeds. There is no more beautiful plant than the white form of *F. meleagris*, nor more charming than the different forms of *F. pyrenaica*, nor more delightful than *F. tubiformis* var. *Moggridgei* with its large yellow flowers speckled with brown, on a north bank in the rock-garden at eye level. These are all easy plants to grow but the American species, especially the smaller ones which are extremely decorative, are difficult to cultivate. Miss Beck might have given a fuller description of how she cultivates these charming plants. In fact when one has finished the book one wants to have even more information about the species and their cultivation. There are no hybrids.

The book ends with an interesting chapter on the cytology of the genus and the chromosome numbers of the species, by Mr. L. F. La Cour, M.B.E. The photographs are excellent and so are the plates, though the plate of *F. tubiformis* var. *Moggridgei* does not do justice to its attractive flower. Miss Beck is to be congratulated on a most useful book.

F. C. STERN

"The Pinks Register." Edited by F. R. McQuown, M.A. 24 pp. (The British National Carnation Society). 2*s*. 6*d*.

This extremely useful Register was prepared by a sub-committee at the direction of the Council of the B.N.C.S., acting on the recommendation of the Pinks Committee. The Register includes Pinks listed by nurserymen from 1950 to 1952 and Pinks shown to the R.H.S. from 1935 to 1952 inclusive. The explanations and definition of terms help to clarify the difficult problems of nomenclature and Mr. McQuown has been guided throughout by the principles laid down in the provisional draft of "The International Code of Nomenclature for Cultivated Plants" (Stockholm 1950 and London 1952). In Part I, terms such as *group*, *selection*, *line*, *clone*, *cultivar* etc. are defined and the Pinks are divided up accordingly. Part II consists of an alphabetical list of cultivars (cultivated varieties) giving the group, the raiser, the introducer, parentage where known, date of raising, a brief description and R.H.S. awards received. "The Pinks Register" is a valuable contribution and similar lists for other genera will be awaited with interest.

LANNING ROPER

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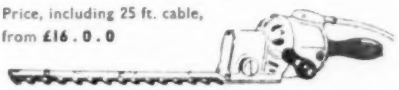

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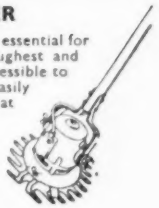

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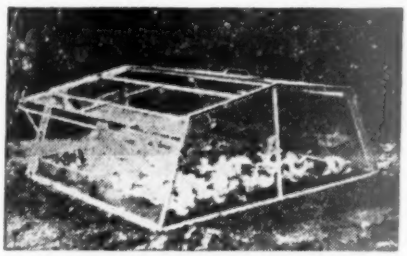

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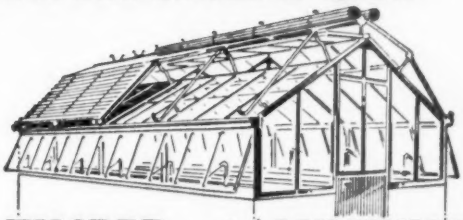

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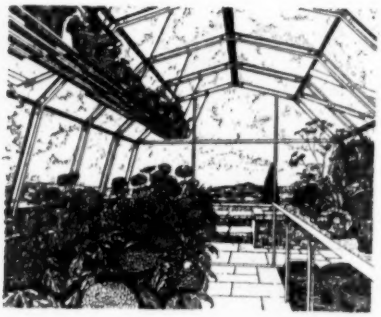

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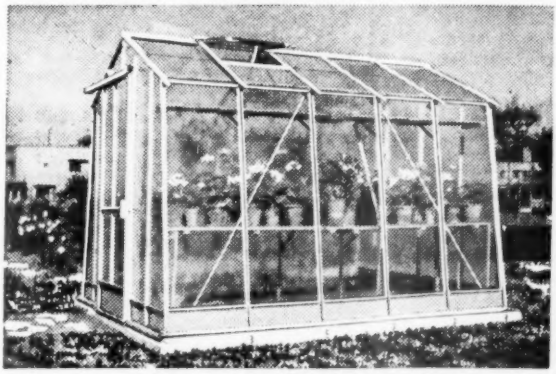

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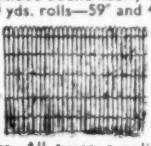

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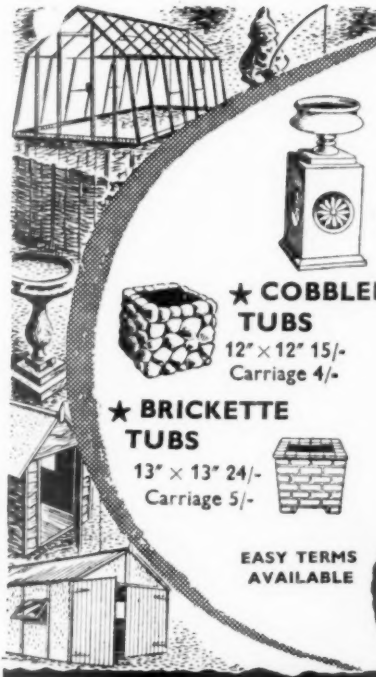

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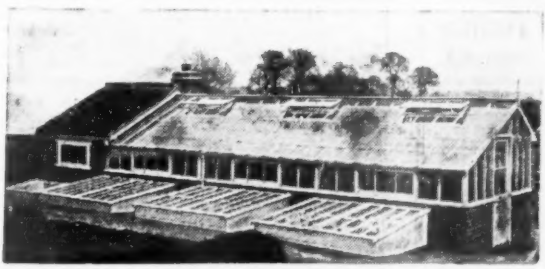

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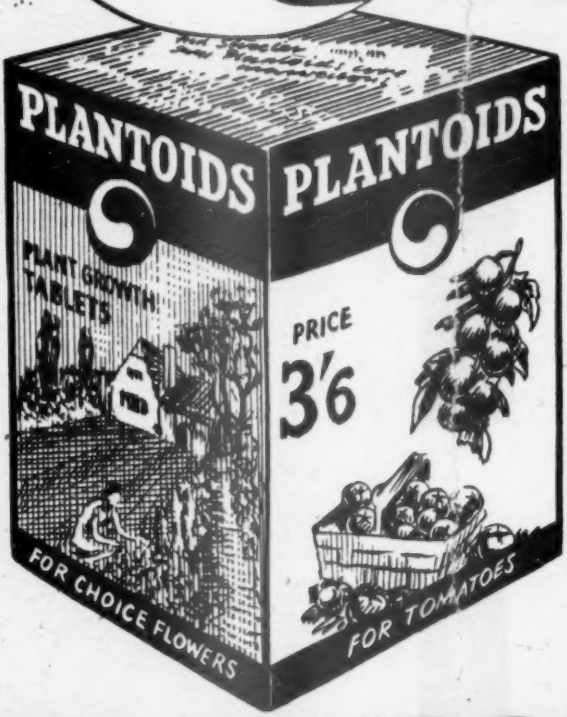
"Plantoids do plants a power of good"

says **FRED STREETER** V.M.H.



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Potash (K_2O) 9%
Phosphoric Acid (P_2O_5 Insol.) 12%
PLUS
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